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ADHESIVES AGE

MANUFACTURE, APPLICATION, TECHNOLOGY, RESEARCH AND MARKETING

SEPTEMBER, 1960

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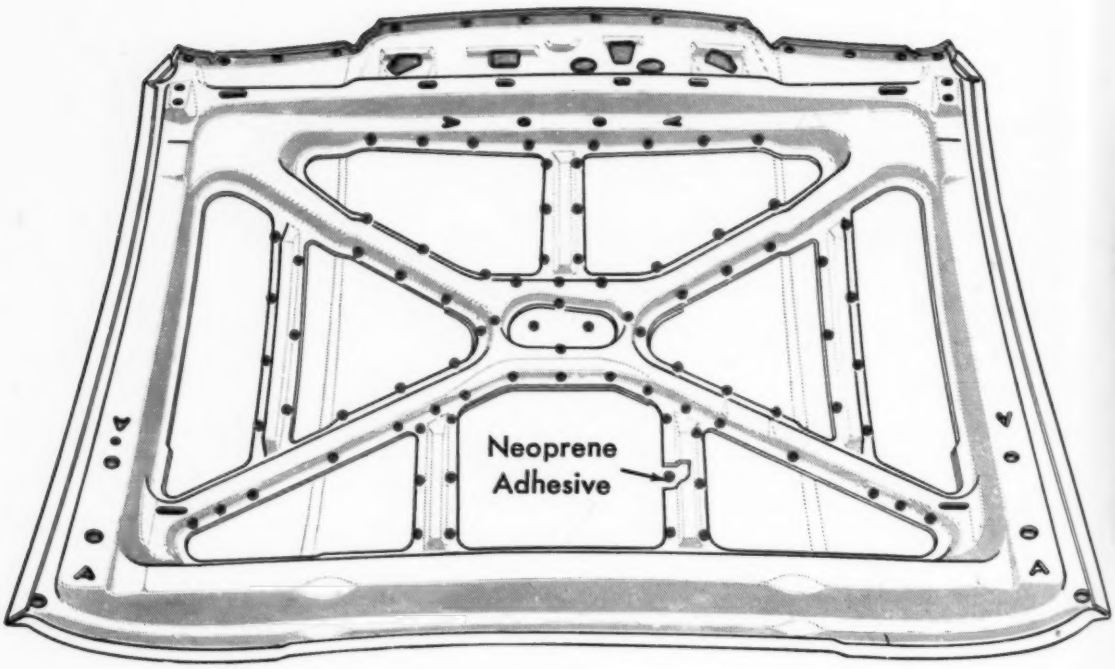
Vol.3
No.9

THE UNIVERSITY OF MICHIGAN
OCT 14 1960
ENGINEERING

Production Line Bonding of Teflon to Aluminum



90 NEOPRENE "SPOT WELDS" SAVE WEIGHT, DAMPEN VIBRATION IN FORD HOOD PANELS

As an improvement over conventional assembly methods, Ford Motor Company uses a neoprene adhesive to join the large 6-foot-wide outer hood panel to its reinforcing inner mate. Application is automated to simplify production. The multiple neoprene welds actually save weight. And best of all, resilient neoprene soaks up hood vibration and noise, completely eliminating the cost of asphaltic paper or mastic deadeners.

Ford automatically extrudes the 90 adhesive daubs in two shots, positions the inner panel and hem welds the edge. Air drying on the way to the paint shop, the neoprene adhesive reaches a partial cure, which protects it from cleaning and phosphatizing chemicals. In paint ovens, the "spot welds" are completely cured. The adhesive's ability to adhere to oily metal and remain in position without slumping during paint bake exposures is chiefly responsible for the success of the new method.

Neoprene-based adhesives are available from adhesive manufacturers in both solvent and latex types. They can be formulated for application by brush, spray or roller and meet a wide variety of service requirements. If you need a better adhesive, ask your supplier about adhesives based on Du Pont neoprene, or write E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department AA-8, Wilmington 98, Delaware.

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ADHESIVES AGE

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About the Cover Photograph

The close-up photograph on this month's cover shows a strip of adhesive-coated Teflon being wrapped around the anodized aluminum shaft of a variable pitch propeller. Though normally considered a hard-to-bond plastic, the Teflon is bonded securely enough to resist the high compression caused by changes in propeller pitch. See the article beginning on page 22 for further details.

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PP PALMERTON PUBLISHING CO., INC.

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what is GRAM?

To the animal glue manufacturer, buyer or user, "*gram*" doesn't mean HOW MUCH. It means HOW STRONG.

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News about

B.F.Goodrich Chemical *raw materials*

FDA finds Geon 443 vinyl resin acceptable for food packaging

Geon 443 adds another advantage to users of solution resins for adhesives or packaging—compliance with recent Food and Drug Administration regulations. Geon is ideal wherever excellent adhesion, strength or clarity is a requirement.

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Adhesion of Geon is good to metal, glass, wood, masonry or paper. For more information on how Geon solution resins can help you, write Dept. GB-2, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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EDITORIAL

Diversification

There used to be a time in the history of American industrial development when a given company would say: "We make the best lawn mowers" and there was no equivocation in this accounting. The direction of the American economy during this decade has diluted this kind of approach. Today, a given company's interests may be so diversified, that it is no longer quite so certain in its claims or even of what it is producing. This matter of *diversification* may be the key.

It will be remembered that early battles about unionization used to revolve about much the same point. Here it was the concept of the "craft" versus an over-all "industrial" approach. It was argued that the craftsman did a specialized job and did it well. There was pride in craftsmanship that the industrial approach did not allow.

And so we see today the parallel. "We make the best lawn mowers—and, oh yes, have you heard about the radio station we own and our new bottle cap plant in Paducah?". This whole matter of diversification can be justified, of course, by our economic and tax structure. What we are speaking of here is the psychology of the situation, or the attitude of management, if you will. And by diversification we mean not that which comes as a natural consequence, but that which is artificially created. For example, it would be perfectly natural for a magazine publisher to undertake the publication of books. It would be less natural for the publisher of magazines to undertake the manufacture of brooms.

Since the trend toward diversification is so great, even smaller companies find themselves with several *emotional* outlets for their thinking. The president of a company today may have to know as much about fertilizer as he does about wheel barrows. Under these conditions, he becomes less of a craftsman and more of an organizer.

We would think that the problem is shared by all industry in the United States. The situation may have been forced upon industry by the tide of events. The time may now have come for a re-examination of trends and for a re-evaluation of the psychological as well as the financial implications.

We would state that this is not only a matter for the adhesive industry to concern itself with, it is a matter of concern for all industry. Let us put the situation this way. It is part of our folk lore that when you build a better mouse trap the world will beat a path to your door. The manufacturer's heart and soul went into the mouse trap—he stood behind his product—he improved it—and, as a natural consequence, he profited.

Today, the manufacturer of brand "X" may only be producing product "Y" to provide a proper tax loss to cover product "Z." The concept of this "X"—"Y"—"Z" formula may be equitable from a profit-taking standpoint, but where are the *craft* values, where are the *moral* values?

We offer no panacea for the ailment—if one exists. We do not state that quality is lacking from the myriad products manufactured in the United States. We do believe that there are inherent dangers in the course followed by so many today. We call these to your attention.

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Stamford, Conn.

CONSULTANT'S CORNER

By Dr. Irving Skeist

Polypropylene to Aluminum

Question: We manufacture automotive parts and have been running into difficulty bonding polypropylene to irradiated or anodized aluminum. The bond must have a tensile-shear strength of 1000 psi or higher. Suggestions?

Answer: Polypropylene, like polyethylene, is difficult to bond to other materials. The first step in cementing a polyolefin plastic is the preparation of the plastic surface to make it more receptive to adhesives. Several methods are available.

In the heat treatment of film, the web is wrapped around a cold roll while the exposed surface is subjected to hot gases or a gas flame. Electron bombardment is accomplished by passing the plastic between electrodes across which a high voltage corona discharge takes place. Chemical agents such as chlorine, chromic acid, and sulfuric acid/sodium dichromate may be preferred for molded pieces.

The most common adhesives for polyolefins are pressure-sensitive compositions based on polyisobutylene or polyvinyl ethers. They have good tack, but only fair strength properties. At Bell Laboratories, polybutadiene has been found to give a strong bond between polyethylene and brass; this synthetic rubber may likewise be useful for the adhering of polypropylene to aluminum. A nitrile rubber based solvent cement may also be worth trying.

Q-160

Copper to Polystyrene

Question: I am engaged in a study of the electrical properties of adhesives used in bonding copper foils to thermoplastic (mainly of the polystyrene-type) boards. Could you suggest some suitable adhesives of high bond strength and low dielectric loss?

Answer: A nitrile or neoprene rubber, blended with phenolic resin, is probably suitable. The adhesive should be applied to the copper from solution, and the solvent evaporated to leave a tacky surface. Then the adherends should be mated and heated to a temperature below the softening range of polystyrene (80°C.) to cure the adhesive.

An epoxy adhesive may have merit, especially a flexible composition curing without external heat.

Q-162

CONSULTANT'S CORNER

Polyvinyl Chloride to Cotton

Question: We have a problem in bonding raw, untreated light-weight cotton cloth to polyvinyl chloride sheet materials. The adhesive used for laminating this combination must not contain evaporating solvents of any kind. Full bond strength should develop within a few hours at room temperature.

The finished laminate must be able to withstand a baking temperature of 135°C. for 12 hours and subsequent immersion in transformer oil continuously without impairing the quality of the bond under operating conditions in oil at 105°C. continuously. Under these operating conditions the adhesive cannot be affected by the oil nor shall it cause contamination of the oil. It is furthermore desirable that the bond not harden materially with age.

Answer: An operating temperature of 105°C. is quite severe for the polyvinyl chloride sheet material itself, especially in contact with oil. Both the sheet and the adhesive must be formulated cautiously, avoiding plasticizers that are volatile or soluble in oil.

Orthodox vinyl adhesives need heat. It is not clear whether water is permissible. If it is, then good results may be obtainable from a polyvinyl chloride latex to which a nitrile rubber latex is added as a polymeric plasticizer. The water is evaporated to consummate the bonding process. If neither water nor solvent can be tolerated, a plastisol should be formulated from a vinyl chloride resin and a combination of polymeric and high boiling plasticizers. The plastisol can be fused at 325° to 350°F.

In our laboratory, an unconventional approach has been utilized to bond vinyl at room temperature and without solvents.

Q-161

Vinyl or Terephthalate to Wood

Question: Our company manufacturers machined wood parts and we are now interested in the possibility of bonding vinyl and Mylar to wood. We would like information about the application methods and about surface preparation of the films and adhesives.

Wood can be heated to from 250° to 300°F. for only a few minutes without damage. Therefore, we desire a room temperature application. The film must appear clear on the wood surface.

Answer: Vinyl sheet can be bonded to wood with proprietary water-base adhesives containing vinyl chloride polymers and nitrile rubbers. For polyethylene terephthalate films, the adhesives may be either a phenolic/nitrile cement or a flexibilized epoxy. Precise formulation of the adhesive, as well as the bonding technique, would vary with the softness and moisture content of the wood and the plasticizer content of the vinyl.

Q-164

Dr. Skeist is associated with Skeist & Schwarz Laboratories, Inc., 89 Lincoln Park, Newark 2, N.J. He is the author of the recently published book, "Epoxy Resins."

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new adhesives

AND ADHESIVE PRODUCTS

Concrete Sealer

Cracks and expansion joints in concrete and black top surfaces can be sealed with a newly developed cold liquid emulsion. Monroe Por-Cold Sealing Compound provides an

elastic filler and surface seal that cannot be disturbed by mild shifting of pavements and walks due to expansion and contraction, states the manufacturer. Developed from ductile grades of asphalt, the inert mineral filler adds stability yet pours and penetrates as readily as water. After setting, it will not run due to hot baking sun, or become brittle during cold freezing temperatures. By placing it in a cone shaped container, the emulsified material can be poured in a crack with a minimum of labor and expense. No heating required. *Monroe Co., Inc.* **P-363**

Gummed Tape

An all-purpose sealing tape, Gilman Gummed Tape, is said to reach peak adhesiveness within five seconds after moistening and retain fluidity and tackiness for 20-25 seconds. An exclusive "pliantizing" process eliminates the tendency of the tape to curl. It is manufactured in standard widths, and 35#, 60# and 90# weights, and a choice of flat or ribbed gumming. Colors available include brown, white, black, grey, green, red orange, blue, yellow and chocolate.

The same manufacturer offers "cold-rolled" reinforced tape in four types: two-way and one-way asphaltic laminated reinforced and two-way and one-way non-asphaltic laminated reinforced. Uniform glass fiber is laid between two plies of 100 per cent sulfate kraft and bonded with a high melting point asphalt laminant or non-asphaltic substance to weld the strips together as one. *Gilman Paper Co.* **P-364**

Pad Glue

The use of Nu-Edje Carb-N-Set Penetrating Glue to pad NCR paper forms is said to cut the cost of separating sets by 84 per cent as they do not have to be separated one at a time. A two-inch lift on the unglued side is raised and the sets fanned apart. The glue is absorbed into the paper and binds between the sheets. No residue is left exposed on the outside edge. The product, which is used directly from the original container, requires no heat and is said to have a pleasingly fragrant odor. Brushes can be cleaned with water. *Carb-N-Set Business Forms.* **P-365**

Epoxy Adhesive

A tensile shear of 2200 psi at 300°F. on aluminum to aluminum is said to be available with Hysol 4322, an epoxy adhesive. The thixotropic, 100 per cent solids paste will not flow during cure. Said to be ideally suited for bonding porous surfaces, as well as metal, plastics, ceramics, glass and wood. The adhesive film has a slight resiliency which insures against cracking during thermal shock. The one-component adhesive has a shelf life of 14 months at room temperature. *Hysol Corp.* **P-366**

Cold Solder

TwinWeld Cold Solder is designed to eliminate welding and soldering in a variety of manufacturing and repair applications. The plastic-base adhesive cures with heat and requires no liquid hardener. The bond it forms can be sanded, painted and finished like steel itself. A long pot life makes mixing large batches economical. Said to be ideal for small production runs and experimental, low-cost tooling. *Schramm Fiberglass Products.* **P-367**

Modified Epoxies

Three new Scotch-Weld two-component modified epoxy resin adhesives that cure at room temperature under contact pressure are available for high strength metal and plastic structural bonding applications where heat and/or pressure are not feasible. All three maintain high strength properties over a service temperature range of −67° to 160°F. Shear strengths of metal-to-metal assemblies bonded with these adhesives range from 2300 to 3200 psi at 75°F. service temperature. They are said to

have high creep resistance under constant stress and good resistance to water, hydraulic oil and aromatic fuels.

Adhesive EC-1751 provides metal-to-metal bonds with shear strengths of: 1400 psi at −67°F., 2300 psi at 75°F., and 800 psi at 180°F. The non-sag properties of this adhesive enable it to be applied in thick layers for contouring purposes. When cured, it can be sanded, machined and painted. Adhesive EC-1838 provides metal-to-metal bonds with shear strengths of: 1500 psi at −67°F., 3200 psi at 75°F., and 800 psi at 180°F. Adhesive EC-2054 provides metal-to-metal bonds with shear strengths of: 1400 psi at −67°F., 3000 psi at 75°F., and 800 psi at 180°F.

The adhesives will cure to maximum strength in approximately seven days. A more rapid cure can be obtained by oven-heating or use of infrared lamps. *Adhesives, Coatings and Sealers Division, Minnesota Mining & Mfg. Co.* **P-368**

Fabric Mender

Especially designed for fabric repair, Darn is a non-toxic and non-flammable mender that will withstand washing, ironing and even boiling once it has dried. It can be used with wool, cotton, canvas and leather. The fabrics to be mended may be overlapped or a patch may be used. The product is effective on synthetic fabrics if a cotton patch is used. *Woodhill Chemical Co.* **P-369**

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Electrical Tape

No high temperature baking is necessary for the cure of Permacel 870 Polyester Film Pre-Set Electrical Tape. It has a thermoset adhesive which makes it resistant to the solvent action of electrical varnishes. The adhesive will not soften at elevated temperatures. Extremely thin, 870 has high tensile and tear strength with excellent elongation for a snug wrap on irregular surfaces. It provides Class B insulation, will withstand temperatures up to 150° C. and is odor free. Principal uses are banding field and armature coils and holding down lead wires in motor and generator manufacture; as a capacitor wrap; in coil manufacturing to hold down start and finish wires, secure leads, insulate cores and provide an outside wrap. *Permacel.* **P-370**

Penetrating Marble Seal

A penetrating sealer which prevents marble surfaces from staining and discoloring, Watco Marble Seal, has been announced. It is an oil and resin polymerizer that seals the pores of marble and similar stone products from within. It is merely wiped on and allowed to penetrate. The surplus is then removed, leaving a completely sealed surface. One gallon covers 400 to 500 square feet. *Watco-Dennis Corp.* **P-371**

Fabric Label

Formed of rayon-acetate material, the FAB K-3 is said to grip firmly to a wide variety of surfaces, including leather, wood, rubber, metal, glass, paper, clothing and other soft goods. Its flexibility allows it to form smoothly on curved and spherical surfaces. The labels will not withstand laundering or cleaning, but will adhere to soft surfaces despite repeated tugging and twisting. Available in various sizes, shapes and colors, the labels can be printed, typed, rubber-stamped or marked with a ballpoint pen. *Avery Label Co.* **P-372**

Wallboard Adhesive

Hardboard or wallboard can now be installed on existing plaster, plasterboard, wood, concrete or other smooth surfaces with 3M Brand Wallboard Adhesive. The mastic-type rubber bondant has a high initial wet strength before drying and good ultimate strength. When bonding prefinished hardboard to existing wood wall, an average shear strength of 270 psi is obtained. The paste-consistency adhesive fills and levels any slight irregularities in the wall surface to insure complete contact with the wallboard. It may be applied by both the "floating" or "buttering" methods. With the "floating" method a notched trowel is used to apply the adhesive to the back of the wallboard which is then firmly pressed into place. With the "buttering" method the adhesive is applied across the back of the wallboard in spots of about two inches in diameter and one inch deep spaced approximately one foot apart. The wallboard is then pressed to the wall with a sliding action to smooth the adhesive. Wall surfaces must be clean, dry and free of contaminating material. *Adhesives, Coatings and Sealers Division, Minnesota Mining & Mfg. Co.* **P-373**

Sealing Compound

SR 278-90 is designed to meet conditions of extreme heat and hard-to-handle fluids. Based on Viton, this compound complies with MIL-R-25897C, Types I and II, Class 2. Said to be ideal for most static sealing applications, it can be bonded to metal, or it can be molded into O-rings and other shapes. The compound maintains its physical and chemical characteristics at temperatures ranging from −65°F. to more than 600°F. O-rings and gaskets made with it provide positive sealing against solvents, lubricants, fuels, hydraulic fluids, acids and bases, states the manufacturer. They are also completely resistant to hot hydrocarbons and other hard-to-seal fluids. *Stillman Rubber Co.* **P-374**

Release Coating

Tar-Dux is a plastic coating for paper, fiber and corrugated containers. It releases sticky materials such as adhesives, tar, asphalt, butyl rubber, resins and waxes. Hot items up to 400°F. or more can be tolerated in the pour operation. The product comes in two forms, both water dispersions of resins. One form is a dull finish, high non-blocking compound and the other is a high gloss finish compound which is non-blocking at 175°F. face to back. Tar-Dux forms a flexible, transparent surface film that adheres without flaking or tearing when dried at 250°F. or higher for 30 to 60 seconds. It can be applied to paper in the roll, to finished fiberboard by roller coating or spray applications, or to assembled containers by spray or slushing. *Dri Dux Div., Resisto Chemical, Inc.* **P-375**

Wood Filler

Easily applied with a putty knife, Magic Wood hardens quickly without shrinking. It is available in seven colors: natural, maple, birch, redwood, mahogany, oak and walnut. All are said to take stain, paint or varnish in the same manner as real wood. The cured compound can be nailed, screwed, sawed and sanded. It will stick fast to wood, metal, masonry and other building materials. *Magic Iron Cement Co.* **P-376**

Sealing Material

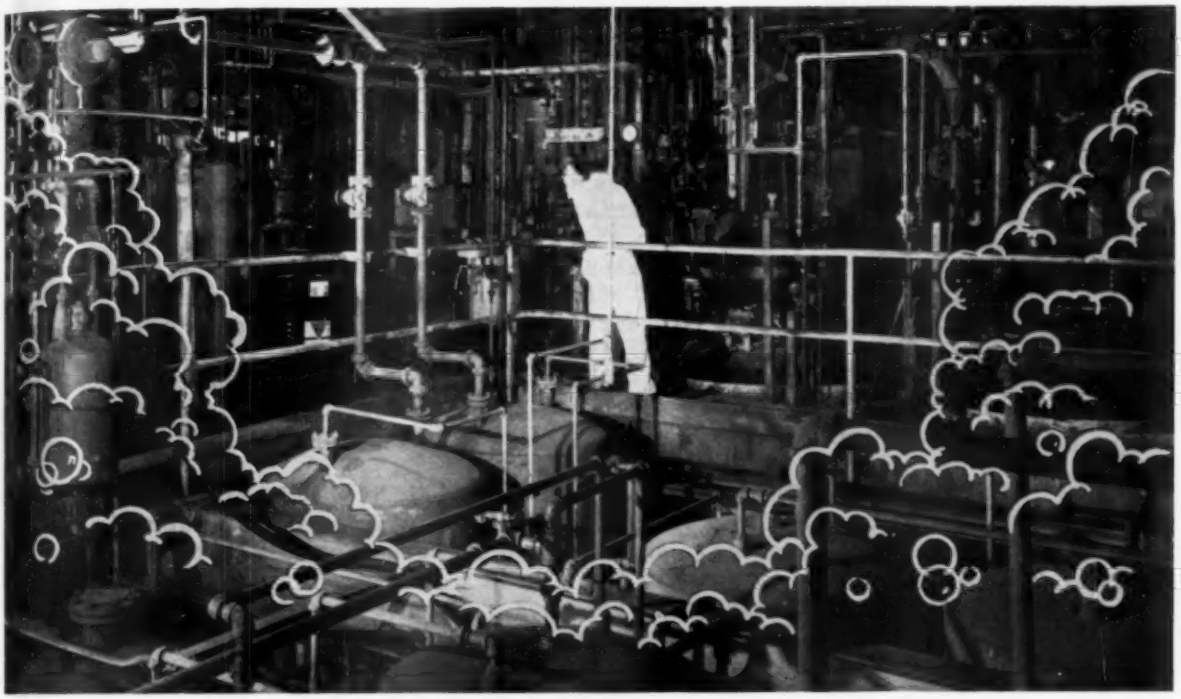
Made according to a special foaming process, Compriband is fully impregnated throughout with bitumen. The material is uniform, porous and similar in appearance to sponge rubber. It can be kneaded and pressed to any shape and returns to its original form in a comparatively short time. When compressed it does not expand sideways and is fully watertight. It is used in conjunction with a Compri-Adhesive and will adhere to a clean surface. *Asbiton AG.* **P-377**

Liquid Lock Washer

Nuts, bolts and screws can be sealed and secured with Lock-It, a new liquid lock washer. A special applicator nozzle facilitates getting at hard-to-reach areas where the nut meets bolt or screw meets wood. The compound works its way around the threads and forms a tough plastic bond which will resist vibration and repeated stress, states the manufacturer. Resistant to oil, water or gasoline, the compound must be applied to a clean, greaseless surface and allowed to dry for one hour. *Woodhill Chemical Co.* **P-378**

SILICONE NEWS from Dow Corning

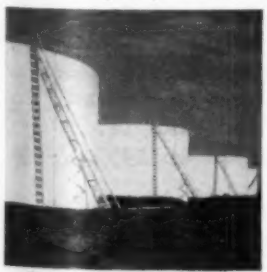
Foam Eating Into Profits?



Job-proved Dow Corning Defoamers Speed Processing, Raise Capacity

Ever try to blow up a balloon with a hole in it? Hard to get it up to any size, isn't it. The same's true of foamers . . . with Dow Corning Silicones added. Silicones put holes in bubbles . . . keep systems foam-free! They're perfect foam controllers: reliable, economical, safe, easy to use . . . quickly available from Dow Corning warehouses conveniently located to expedite shipment to you.

No Hold-Ups. No Foam-Overs. Production slow-downs caused by foam are eliminated when fast-working Dow Corning Silicones are added to systems. The absence of foam permits you to make more efficient use of equipment, step up production and meet schedules never before thought possible. Capacity is increased, and foam-overs are prevented . . . thereby cutting cost of clean-up and maintenance and helping reduce fire hazards.



Eliminate foam-overs here.

What's Your Foamer? Today, Dow Corning Silicones are used both as antifoamers and as defoamers in processing chemicals, petroleum products, asphalt, textiles, paper, paints, adhesives . . . in metalworking and laboratory work . . . in virtually every industry and process — even in food processing where the use of Dow Corning Silicones at designated levels is sanctioned by FDA.

If you're troubled with foam slowing down your plant operation, taking up productive capacity, or creating maintenance, it'll pay you to test Dow Corning Silicones.

New Literature and Free Sample. A new 8-page manual, "The ABC's of Defoaming", will help you learn all the facts about Dow Corning silicone defoamers . . . how and where to use them, examples of the small quantities of silicones needed to control foam, and typical successful applications. Write today for your FREE copy and ask for a generous FREE SAMPLE of the silicone defoamer that you can test . . . that will likely give you the most efficient, most economical defoaming action. Indicate your type of foamer: aqueous, oil, food or other. Address Dept. 0109.

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capitol cues

THIS FALL'S CAMPAIGNS WILL PROBABLY QUICKEN THE TEMPO of business. That's Washington's feeling these days, now that the conventions are over. Government economists think that the electioneering will stimulate business until the voting in November. Thereafter, things may begin to ease a bit.

The optimism of the candidates is expected to be contagious. Businessmen and government officials will tend to act to keep business activity high--ordering more and spending more. So, jobs and sales will rise a bit more than usual. Thereafter, there may be a period of uncertainty--a pause no matter who wins. An easing in Winter might coincide with the appearance of other weaknesses and help bring on a recession next year.

THE NEXT PRESIDENT WILL ENLARGE THE GOVERNMENT'S ROLE--no matter who he turns out to be. Both parties have adopted platforms calling for bigger defense and welfare programs. And the word in Washington is that both of the candidates mean to live up to the platform promises. This means Nixon would veer away from Eisenhower's policies. GOP strategists concede their platform is something like the Democrats'. But they note vital differences.

-Similarities include the emphasis on economic growth and stepped-up programs for education, old-age medical care, aid to depressed areas, and medical research. The GOP has also promised to increase minimum wages and unemployment payments.

-Differences are equally significant. Republicans would not go for easy credit. On taxes, they would stress changes to encourage investment; Democrats talk more of curbing expense accounts and plugging loopholes. On labor, the GOP position is to oppose liberalizing the Taft and Landrum-Griffin Acts.

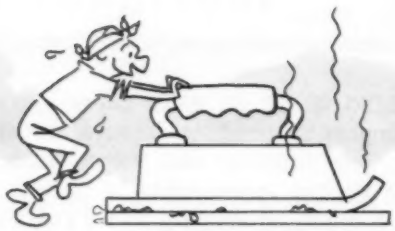
So, while both parties will move in the direction of bigger, bolder programs, there'll be important differences of degree.

THE TREND IN CORPORATE PROFITS SIGNALS SERIOUS PROBLEMS ahead for a great many firms. During the second quarter, earnings were about 13% below the rate in the same period of last year. Significantly, though, sales were actually up a little. So the squeeze on profit margins reflects increased costs of all kinds--wages and services like transportation, for example. What's more, recent productivity gains have not been as large as in 1959.

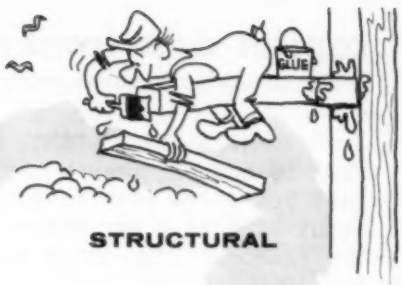
-The biggest declines from the second quarter of 1959 came in construction materials (down 20%), automobile equipment (25%), machinery (27%), metal products (30%), the railroads (45%), and iron and steel (a whopping 52%). Auto profits were off 9%. In rubber, they fell 1%. And in drugs, they dipped 8%.

-What earnings increases occurred centered in office equipment (up 20%), finance and oil (15% each), utilities (9%), paper (4%), food and tobacco (4%), and nonrail transportation (2%).

HOT MELT



HEAT SEAL

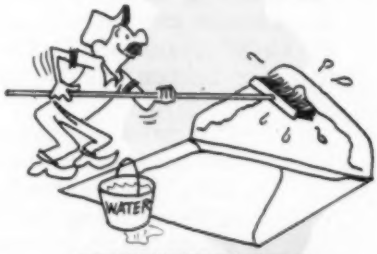


STRUCTURAL

PACKAGING

SOLVENT

GENERAL PURPOSE



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- 5 grades of BUTVAR polyvinyl butyral resins
- 4 grades of FORMVAR polyvinyl formal resins

Shawinigan has specialized in serving adhesives manufacturers for more than twenty years and can offer you outstanding experience and service. Coast-to-coast warehousing helps us to meet your delivery requirements. Combined shipments of two or more products at the truckload price for each offers extra economy. Shawinigan's technical staff assists customers in the most efficient use of our adhesives raw materials while constant R&D activity pioneers new products.

To take advantage of this assistance in producing adhesives, please write Shawinigan Resins Corporation, Dept. 92, Springfield 1, Mass.

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capitol cues (cont'd)

PRODUCTIVITY ISN'T RISING QUITE AS FAST these days as it did in 1959. That is one big reason why corporate profits aren't doing as well as hoped. Last year, the rise in output per manhour was very large in nonfarm lines--about 4.2% to 4.4%, according to the government's Bureau of Labor Statistics. The reasons: Efficiency always goes up during the first year of a recovery. For 1960, though, Labor experts say they expect to see gains of 3.3% to 3.5%. Why? Because in an upturn's second year, cost-cutting drives generally wane. Business starts hiring more nonproduction help--clerical...research...sales.

NEXT BIG LABOR NEGOTIATIONS will come in electrical manufacturing in October, when five-year contracts with General Electric and Westinghouse expire. All signs point to a rough fight, with management standing firm. The Electrical Workers want some 15 changes--all allegedly noninflationary--including fringes and wage increases of 3½%. But both firms will oppose big pay increases. And they want to kill cost-of-living escalator clauses. With the economy weakening, management will offer little and make it stick.

THIS WILL BE A BIG CROP YEAR FOR FARMERS, rivaling the record of '58. That's the word now coming from officials at the Department of Agriculture. Plantings were high and, recently, the weather has turned highly favorable. As a result, farmers' net income will be somewhat better than it was in 1959. (In 1959, low market prices brought farmers' net down to about $11 billion.)

Here is the latest official estimate for the major farm crops:
-Cotton: The 1960 crop will exeed 1959's 14.5 million bales.
-Wheat: Latest estimates are for 1.4 billion bushels--up 23%.
-Corn: A crop of 4¼ billion bushels is seen--only 2% below peak.
And early targets are being raised for other grains and soybeans.

CURRENT DECLINES IN THE BIRTH RATE will have a big impact on business if they continue for a prolonged period of time, say U.S. population experts. The rate is down 4% from a year ago. It has been falling for nine months now. One reason may be the small proportion of women in the high fertility bracket--20 to 30 years old. This could partly reflect low births during the Thirties. Another factor may be that parents are now deciding against larger families.

The rate may go up again soon, however. The experts are still reluctant to assign any real significance to the recent trend. But, they concede that if the downturn continues, it could be a depressing influence on sales of baby foods, furniture, and clothing. It would also curb building of schools and other public works. The Golden Sixties might be a lot less golden.

THE BUSINESSMEN'S BOOKSHELF--new U.S. booklets you may want to get. They are all available for little or nothing from various federal agencies.

-A new federal purchasing directory, to help small firms get U.S. business, is now available. The cost is 60¢ per copy from the Government Printing Office, Washington 25, D.C.

-Small manufacturers' aids--tips on management and how to handle government relations--are collected in a new booklet by the Small Business Administration. It costs 30¢. Write SBA in Washington for "Management Aids for Manufacturers."

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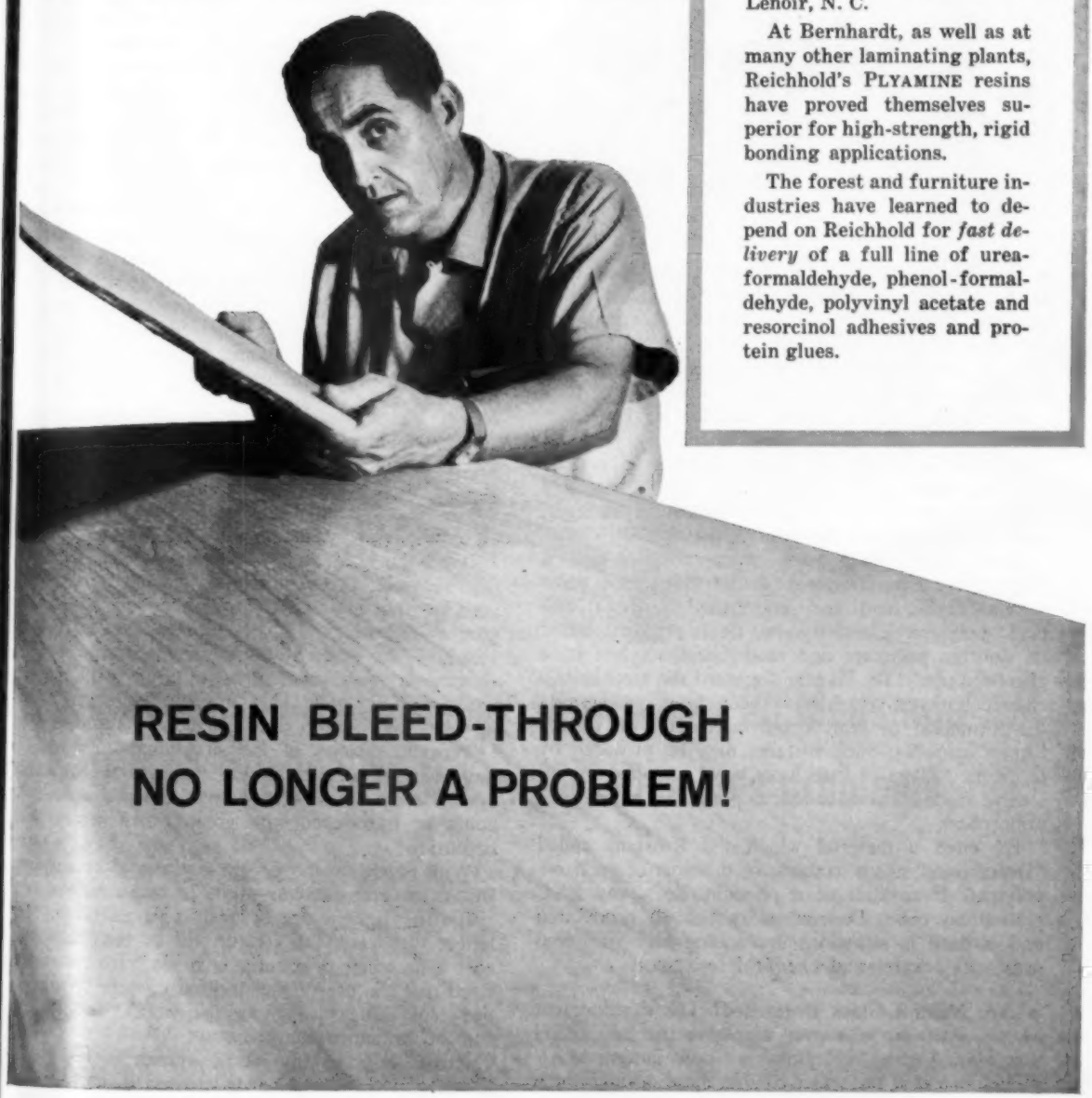
Eliminates Culled Panels with
RCI
PLYAMINE-BASED ADHESIVE

"Thanks to Reichhold's PLYAMINE Resin, we have completely eliminated the serious and expensive problem of defective, or 'culled' laminated wood panels caused by resin 'bleed-through'": Colon Prestwood, Plant Superintendent, Bernhardt Furniture Company, Lenoir, N. C.

At Bernhardt, as well as at many other laminating plants, Reichhold's PLYAMINE resins have proved themselves superior for high-strength, rigid bonding applications.

The forest and furniture industries have learned to depend on Reichhold for *fast delivery* of a full line of urea-formaldehyde, phenol-formaldehyde, polyvinyl acetate and resorcinol adhesives and protein glues.



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• **Decorrosite—a Russian Graft Copolymer.** Dr. M. S. Akutin, the director of the Moscow Plastics Institute, a research organization which is carrying out work of academic interest and is also concerned with the development of new materials, recently addressed a meeting of the British Plastics Institute.

Dr. Akutin discussed less familiar products; for example, a block copolymer of phenolic and epoxy resins and some of the properties of a glass-fibre laminate made from it. He claims that it retains a high proportion of its original mechanical strength, even at temperatures between 300-400°C.

Graft copolymers, made chemically, include a range of common monomers paired with starch, polystyrene-acrylic acid and, interestingly enough, isotactic polystyrene and styrene. Graft products based on fluorine polymers and methyl-methacrylate have also been made. Dr. Akutin discussed the mechanical-chemical means which have been used, particularly the formation of graft copolymerization on freshly formed surfaces. Such surfaces may be provided by inorganic "fillers" which have been activated by intensive mechanical destruction, preferably in an inert atmosphere.

He cited a material which the Russians called "Decorrosite" as an example of this sort of graft copolymer. It consists of a phenolic resin and PVC grafted on coke. Decorrosite is now in production and is used in situations demanding high heat and satisfactory water and chemical resistance.

• **Are Natural Glues Outmoded?** The development of new synthetic adhesives may give the impression that natural glues and gums are now outdated. Although some of the water-soluble natural glues, such as Gum Arabic, have been in use since biblical times, and animal glue was known before the Pharoahs, there are many interesting and promising developments in the field of natural adhesives that make them particularly attractive to many industries.

The gum family, *i.e.* those extracted from seeds, such as Locust, Guar, Quince, Psyllium, etc.; those obtained from the exudation of sap of trees or other plants, like Gum Arabic, Karaya, Tragacanth, Ghatti, Shiraz, Mesquite, Angico, Talha, etc.; and those processed from seaweeds, such as Agar, Kelp, Alginate and Irish Moss; all these exhibit the usual hydrophilic colloidal qualities plus additional properties of specific interest to certain trades.

Some gums possess many times the viscosity of other gums and starches and can be used to replace them with advantage. Locust bean gum for example, gives a low concentration solution of high viscosity; 0.5 per cent gum gives a very thick solution, and a paste of 5 per cent is practically non-flowing.

It could be assumed that the selection of age-old materials like gums and glues is very limited; however, there is a very wide range of natural adhesives and, as natural resources in the East are developed more and more, new products are being introduced to the world market. An example is Guar Gum, which has for centuries been grown in Pakistan and India where it is used as fodder for livestock as well as for human consumption. This gum is used not only as an adhesive filler and sizing agent, but as an additive to many food and pharmaceutical products. In view of its usefulness, Guar is already being grown as commercial crop in some sections of the South-West of the United States.

• **The Metric System in Britain.** The Association of British Chambers of Commerce and the British Association for the Advancement of Science have made an exhaustive study of the advisability of introducing the decimal system of coinage and the metric system of weights and measures.

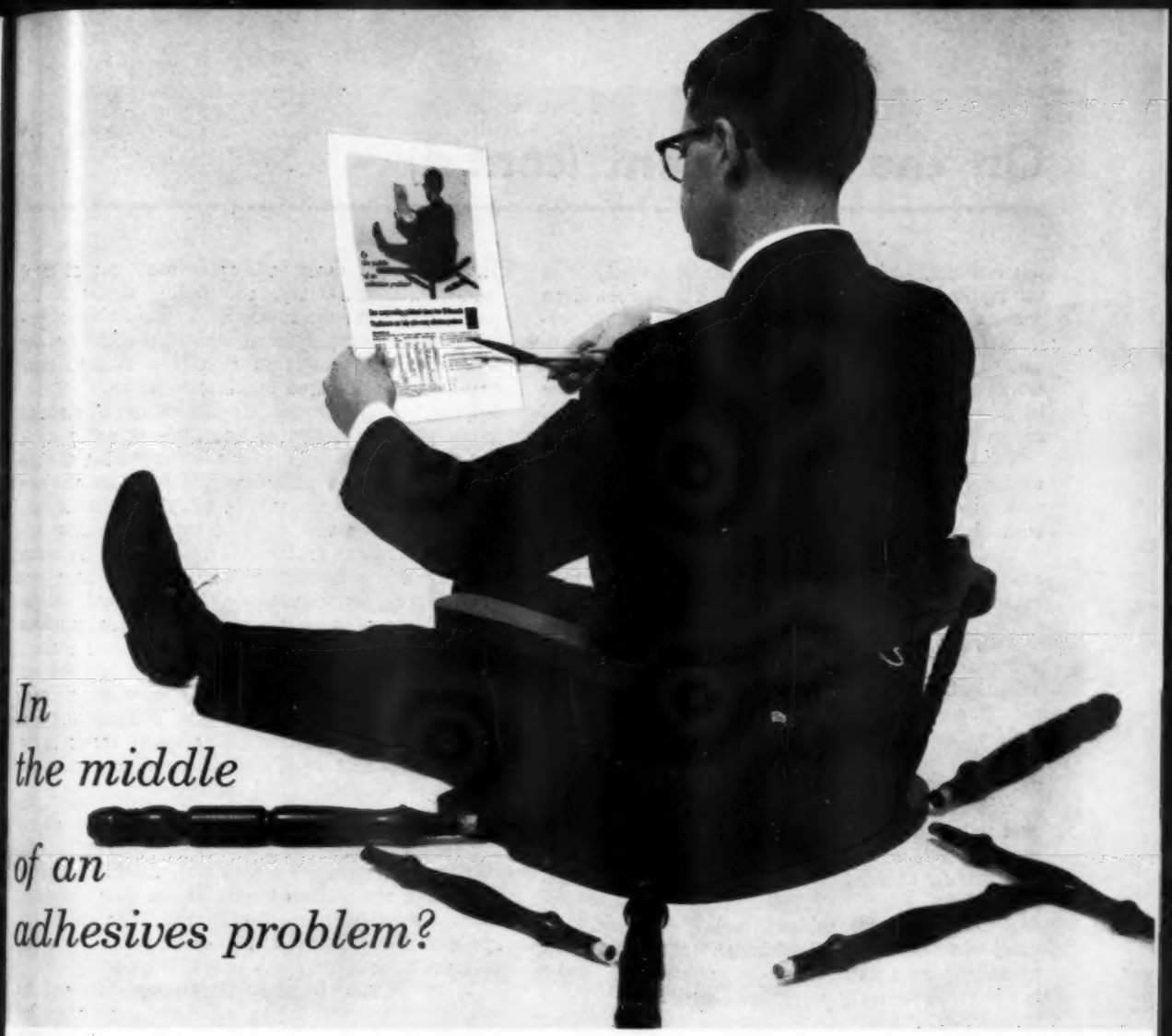
It has been found that there is a general feeling that the metric system would become more widely used in England and in the rest of the world. The government therefore has been urged to keep a close watch on the world situation, preferably through reviews every two years in consultation with industry and commerce, and with appropriate organizations in the United States and the Commonwealth.

Periodic reviews of the situation would indicate the advisability of a rapid changeover to the metric system and in what part of business and industry it could be introduced with greatest benefit and least confusion.

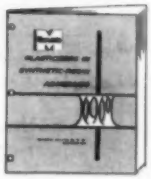
With regard to the decimal system of coinage, the British government was urged to make an early decision in principle for or against its adoption. "The longer the delay, the greater will be the transitional cost if a change is eventually made." It was emphasized that the use of the decimal coinage system has been spreading throughout the world. The same is true of the entire metric system.

Russia adopted the metric system in 1927, and, in view of the many newly created independent republics in Africa and other parts of the world, it can be assumed that Russia will do its best to convince new nations to adopt the metric system, too.

• **Synthetic Melt Adhesives.** These were discussed by L. E. Puddlefoot at a meeting of the London Plas-



New compounding guidebook shows how 25 Monsanto Plasticizers can help solve many adhesives problems



EXAMPLE:

Monsanto plasticizers help tailor PVAc emulsion properties to specific needs

Monsanto Plasticizer	Heat Sealability	Quick Tack	Flexibility	Performance	Relative Cost
AROCLOR 1211	Good	Excellent	Excellent	Good	Low
AROCLOR 1232	Good	Excellent	Good	Good	Low
AROCLOR 1242	Good	Good	Good	Good	Low
SANTICIZER 140	Good	Good	Good	Excellent	Medium
SANTICIZER 141	Good	Good	Excellent	Excellent	Medium
SANTICIZER 160	Good	Good	Good	Good	Medium
TRICRESYL PHOSPHATE	Good	Good	Good	Excellent	Medium
DIMETHYL PHTHALATE	Good	Excellent	Excellent	Good	Medium
DIETHYL PHTHALATE	Good	Excellent	Excellent	Good	Medium
DIBUTYL PHTHALATE	Good	Good	Excellent	Good	Medium
SANTICIZER B-16	Good	Good	Excellent	Good	High
SANTICIZER M-17	Good	Excellent	Good	Good	High
SANTICIZER 1-H	Excellent		Good	Excellent	High
SANTICIZER 8	Good	Excellent	Good	Good	High
SANTICIZER 9	Excellent		Good	Good	High
DIPHENYL PHTHALATE	Excellent		Good	Good	High
TRIPHENYL PHOSPHATE	Excellent		Good	Excellent	High

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On the Continent (cont'd)

tics Institute, who pointed out that an extremely short setting time is a characteristic of melt adhesives. Even when the substrata have smooth, impermeable surfaces (*e.g.* Polyethylene) the interval between application of fluid adhesive and attainment of adequate working bond strength may be reduced to a fraction of a second by accurate control of temperature and extrusion speed of a properly formulated adhesive.

To take full advantage of this property, high speed thermostatically controlled applicators are necessary and must usually be designed to work in conjunction with high speed forming and assembling machinery.

This principle was illustrated by reference to adhesive and corresponding applications as in shoe manufacture and the packaging industry.

• **Polymer Blending.** Of all the areas where rubber and plastics meet, that which includes mixtures of hard rigid plastics and soft flexible rubbers is the one most popular today. Many examples are well known, such as the addition of a little rubber to phenolic molding powder to make it resistant to impact, or the blending of butadiene styrene rubber with polystyrene to reduce brittleness—the so-called high impact polystyrene. A more recent development is the use of blends of styrene acrylonitrile resins with nitrile rubbers to produce a high impact—high softening material.

Blends of nitrile rubbers and PVC, containing small amounts of PVC, although requiring careful processing have exceptional ozone resistance, which is not an outstanding property of nitrile itself. There is, however, one drawback common to all the rubber resin blends and this is a lowering of the aging resistance, but despite this these blends have become of major importance. They are often unpredictable in behavior as they are usually heterogeneous systems with the rubber dispersed in the resin phase.

• **Underdeveloped Nations Eager to Trade.** In a report covering the Leipzig Fair, the Communist trade paper *Plaste and Kautschuk* proudly emphasizes the fact that a number of smaller nations participated at the fair for the first time. Besides Cuba and Ghana there were exhibits by six independent African republics belonging to the French Commonwealth, namely: the Mali Federation, Ivory Coast, Dahomey, Gabun, Congo and Madagascar. The participation of the six African nations corroborates again the eagerness of Soviet Russia to woo these new states in order to bring them into her orbit. The capitalistic world will have to accelerate the establishment of trade relations with the new nations in order to attract their attention.

• **Metal Bonding Congress in East-Germany.** Recently a congress of many experts from various industries was held in Eastern Berlin to inform all participants of developments in metal bonding techniques. The first paper dealt with aging problems of metal bonds, their durability, and testing methods. The author described the research and development program which primarily dealt with light metal bonding tests. Epoxies, heat-cured adhesives, showed better results than cold-cured bonding materials.

Bonding techniques in the apparatus and electrical industry—the bonding of housing—were the theme of the next paper. Experiences in the joining of housing materials, and particular qualifications and necessary jigs were discussed. In talking about the technological aspects and the application of bonding techniques in the construction of machinery, the author reported that a number of bonded joints have been investigated. Demonstrations have proved that in many facets of the industry there exist a multitude of applications. Special circumstances will make it possible to use simplified construction and less expensive processing methods. Another paper dealt with bonding techniques in traffic. The meeting concluded with a paper concerning epoxy resins in the ultra vacuum technique. Cold-curing epoxy resins had been used with very good results.

• **Latex-Cement for Coal Mines.** Glass tiles are helping reduce costs in British coal mines. The tiles are used to line storage bunkers and washeries through which the newly mined coal has to pass. With increased mechanization in the mines, the volume of small coal mined has greatly increased and with this increase have come many new difficulties.

When passing through the storage bunkers, the coal tends to stick to the sides and may cause the flow to stop altogether. In the washeries the coal sometimes builds up into a "slurry" and again causes obstruction. Glass tiles were found to be the most suitable lining. They fulfilled the three most important conditions in that they have a low coefficient of friction to aid the coal flow, good resistance to both abrasion and impact, and they are not affected by corrosion. The tiles, which are bedded in a latex-cement compound which adheres readily to both steel and concrete surfaces, are easy to repair and their price is not too high.

There might be similar applications in many other industries which require special cements. An alert Research and Development Department of a factory producing adhesives could provide interesting information for the Sales Department.

• **The Shortage of Labor in West Germany.** According to the latest official report of the German Ministry of Economics, 450,000 jobs are now open, compared to 276,000 last year. At present there are two jobs waiting for each man who is out of work; less than 186,000 people are unemployed. German industry is unable to increase production because no additional labor is available. Labor is being imported at an increasing scale from Italy, Spain, and Greece.

FOR EXCELLENT ADHESION, LESS SHRINKAGE AND LOW WATER DEMAND, FORMULATE YOUR DRY MIX PRODUCTS WITH THIS SPRAY DRIED REDISPERSIBLE PVAc.

Dry concrete ready-mixes, spackling compounds, powder paints and joint cements for dry wall construction are easier to use and give better end results when formulated with Colton Vinac RP-250 Powder.

Vinac RP-250 Powder, a spray dried redispersible polyvinyl acetate, is a superior, economical binder for commercial fillers. Concentration may be as low as 7 parts to 90 or 100 parts of filler.

Imparting excellent adhesion to dry mix products, Vinac RP-250 Powder cuts the "soaking" period of casein-type cements by half, has lower water demand and, therefore, less shrinkage, and is easier to formulate.

Samples and technical bulletin available on request.

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AT THE FRONTIERS OF PROGRESS YOU'LL FIND . . .

AIR REDUCTION PRODUCT

Bonded Teflon Liners for Aircraft Propellers

A special epoxy mix used to join this hard-to-bond plastic to anodized aluminum provides the high bond strength needed to resist compression caused by propeller pitch changes

In the manufacture of their widely used variable pitch Hydromatic propellers, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn., makes a bonded Teflon liner serve a dual purpose: it reduces friction when the pitch is changed, and also acts as a partial sealer to prevent the hydraulic fluid contained in the propeller hub from escaping.

Similarly, the specially formulated adhesive mixture which they worked out in co-operation with their adhesive supplier also acts in a double capacity: (1) it adheres the treated Teflon to the anodized aluminum propeller blade shank with a bond that is impervious to a wide variety of fuels, lubricants, and external weathering; (2) it provides additional sealing action against environmental conditions.

Such adhesive-bonded shafts are a critical part of the propeller used on the Lockheed Electra, the turboprop transport used by KLM Royal Dutch Airlines and Capital Airlines. They are also used on the U.S. Air Force's Lockheed C-130B turboprop troop carrier. It is the latest refinement in propeller development by a company which has 40 years of experience in the field and whose propellers are used on almost 90 per cent of the free world's propeller-driven commercial transports.

Because of the multiple functions of the adhesive, performance demands on the part of Hamilton Standard fell into two categories. First, they required maximum bond strength between the plastic and the metal so as to withstand the high compression when the propeller pitch is changed in flight for most efficient climb, cruise, descent, etc. One of their specifications called for failure in the treated Teflon rather than in the adhesive when the bond was subjected to destruction tests. This requirement was met by various types of adhesive formulations including, of course, various epoxy-based materials.

The second performance area, which narrowed down the choice of adhesive, required that the completed bond withstand immersion in hydraulic fluids (MIL-H-6083A and MIL-H-5606 type) at 180°F.; isopropyl alcohol; MEK; boiling water; kerosene; Varsol; salt spray; and MIL-G-3278 grease.

Heat Cure Precluded

In addition to these requirements, the production methods as well as the materials used precluded a heat cure.

As testing proceeded, it soon became evident that not only did these end-use service requirements demand the use of an epoxy-based formulation, but there was only one combination of resin and hardener which the Hamilton Standard engineers found could provide the bond strength required accompanied by the environmental resistance demanded—and still be capable of being cured at room temperature.

The adhesive mixture which was finally developed consisted of two products manufactured by Rubber & Asbestos Corp., Bloomfield, New Jersey: Bondmaster M611, a reinforced, 100 per cent-reactive formulated epoxy adhesive originally developed (with a special hardener) for MIL-A-5090B and MIL-A-25463 specifications; plus a specially flexibilized room-temperature-curing Hardener, CH-16.

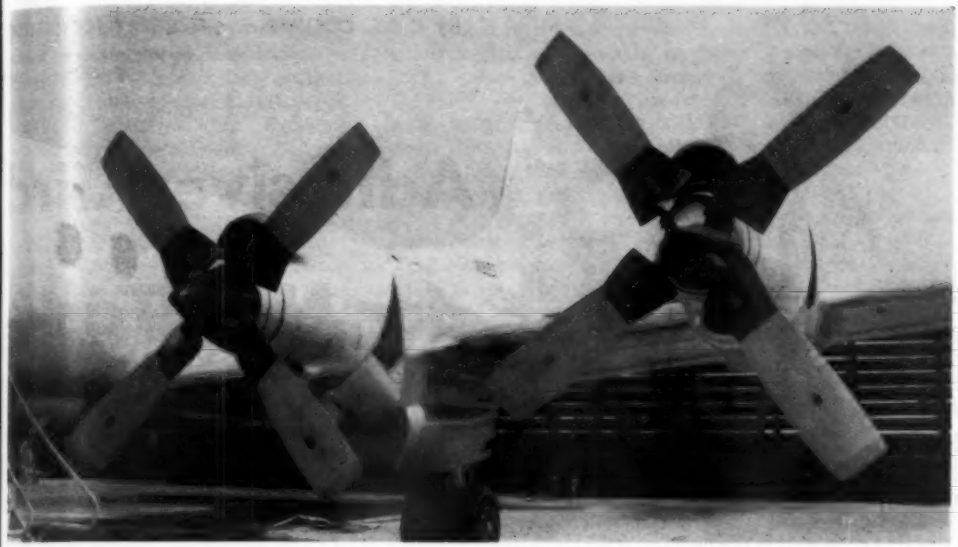
Anodized aluminum shanks of the multiple-bladed Hamilton Standard Propeller are encased in a housing which also holds the various hydraulic oils used for lubrication and hydraulic activation of pitch change. Production of the units has been standardized into a simple four-step operation.

First, the portion of the anodized aluminum blade shank to which the Teflon is to be bonded is chemically cleaned. The treated side of the premolded, semi-circular strip of Teflon which fits around the blade shank is also cleaned prior to the bonding operation.

The next step involves the preparation of the adhesive: 100 parts by weight of Bondmaster M611 are mixed with 32 parts of Hardener CH-16. A six-mil film of the mixture is spread on the prepared side of the Teflon strip. The adhesive is then partially air-cured for 45 minutes before the strip is put in contact with the aluminum shank.

After the Teflon is positioned on the shank, masking tape is then wrapped around the circular piece to hold the ends in direct contact with the aluminum while the balance of the cure takes place at room temperature—a matter of approximately six hours.

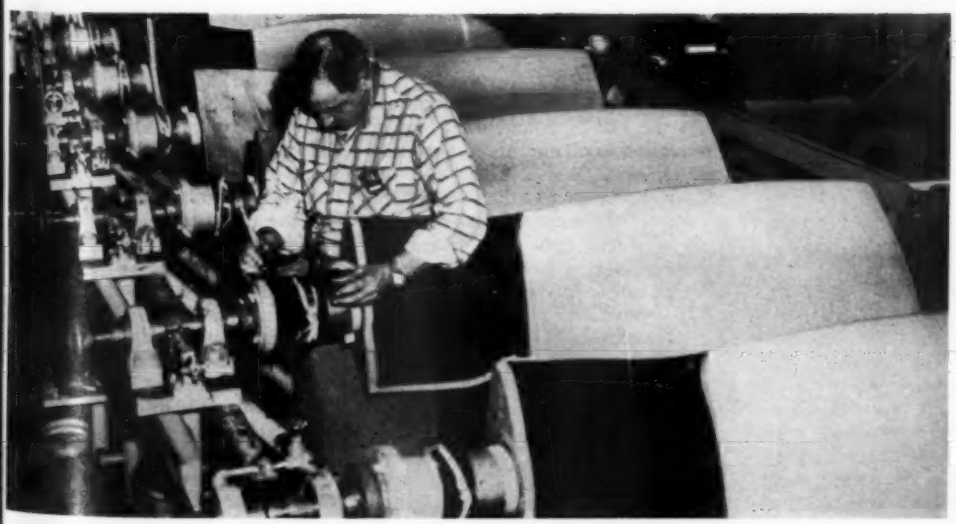
Upon completion of the cure, a special sealer is added to each side of the bonded Teflon strip, and the completed assembly is then ready to withstand all service conditions.



Hamilton Hydromatic propellers such as those shown at the top of this page are used in the turboprop transports that make up the fleets of both the KLM Royal Dutch Airlines and Capital Airlines.

Adhesive-coated Teflon strip is wrapped around a propeller shank. Specifications call for failure in the treated Teflon rather than in the adhesive when the bond is subjected to destruction testing.

A special supplementary sealer required by specifications is added to each side of the bonded Teflon strip while the cure is being completed. At room temperature the cure requires approximately six hours.



By C. W. COOPER and HERBERT JOHNSTON
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Adhesives Gird for New Tasks

Recent improvements in the strengths and formulations of adhesives are opening new markets which may eventually turn out to be bigger than current ones

It is well known that adhesive products and bonding techniques form an important part of modern manufacturing practice. However, the mushrooming growth of the adhesive industry and its present and future impact on our economy bear a second look.

Some of the more mundane, less-noticed uses of adhesives represent fantastically large markets. For example, a reported ten million pounds of adhesives were used in 1957 for applying labels to beer bottles. As for variety, a total of seven different types of bonding agents are required to bring a package of cigarettes to the consumer.

However, adhesive products are moving into much more spectacular end uses than these. By their very nature, some of the new uses now on the horizon will most certainly rival the biggest current single applications.

Until the beginning of the present century, animal glue dominated the adhesive field. If bonding methods were used, it was virtually the only available high-strength material. Pastes and mucilages, based on water dispersions of starches or gums, were also available, but their limited strength, of course, restricted their use. The rosins, pitches, and tars that come under the heading of naval stores might also be considered as early adhesives, but, used alone, they were more applicable as caulking agents, sealants, or water-resistant surface treatments.

Animal glue was the dominant material in an era whose structures were basically of wood. Due to properties peculiar to the protein collagen on which glue is based, it remains an important product today in the bonding of wood and other cellulosics in segments of our industry.

Uses of Casein

The casein-based adhesives, known since the 1870's, found some use in assembling wood aircraft components during World War I. They were selected because of their excellent weather resistance. Casein, together with soybean flour and blood albumin, has also found wide use in veneers and plywood. The plywood and, more recently, the particle board industry consume high tonnage quantities of adhesive products.

According to U. S. Department of Commerce figures, the softwood ply production alone accounted for over 51,700 tons of adhesives as long ago as 1951 (about twice the quantity consumed in 1946). If one adds to this the hardwood products which represent about half the volume of softwood, the effect on the total adhesive market is tremendous. The consumption of natural and synthetic types in softwood plywood is estimated to have reached about 97,000 tons in 1957. Demands and standards set by the industry form a constantly changing picture with respect to adhesive types supplied.

The adhesives industry underwent a revolution with the development of synthetic products. Through the expanded and widely selective properties that became available in specially compounded products, adhesives provided effective fastening for a wide variety of materials, structures, conditions, and products. The growth of synthetic adhesives perhaps had its greatest boost with the development of the plywood and aircraft industries. The demands of the plywood industry included greater heat and moisture resistance; aircraft manufacturers needed, in addition to moisture resistance, high strength, high temperature, and creep-resistant materials capable of bonding metal to metal and metal to other materials to form structural members.

The numbers and types of adhesive products now available are almost limitless and, although this is an ad-

vantage, it tends to confuse the potential user. Guideposts in the selection of the proper adhesive will be outlined in a subsequent section. However, some of the forms in which synthetic materials are available should be mentioned first.

They may be obtained in water solution, in aqueous dispersion incapable of being redispersed or even seriously attacked by moisture after drying, in solvent solution as thermoplastics (heat softened), or in thermosetting compounds incapable of being heat softened after a curing cycle. The latter two classes may be elastomeric or rigid in character and may be employed as so-called contact cements. This means that they may be applied to two mating surfaces, dried, and assembled after the solvent has evaporated, thus eliminating the problem of trapped solvent in nonporous structures.

Fluid adhesives are also available as solvent-free formulations that are curable or that can be applied as hot melts. These require no volatile components and thus eliminate the problem associated with their presence.

New Applications

The improvement in the strengths of adhesives has made them available for use in applications formerly closed to such materials. Many organic adhesive materials—especially those of the aircraft type—are highly heat resistant and offer bond strengths in the 4000 to 5000 psi range. Others promise strengths to 10,000 psi. Of course, such factors as end use, the size of areas to which cements are applied, and the type of stress (shear or peel) will determine the degree of strength necessary.

The rapid growth of adhesives in the past resulted largely from the demand for uniform structural materials ranging from plywood to corrugated board. At the same time, the aircraft, marine, appliance, furniture, container, building, and other industries have been effectively demonstrating another advantage of adhesives—they permit the use of structural methods that can provide products of specialized shapes. Such uses promise to create greater demands for adhesives in the future.

The many advantages of adhesive bonding include: (1) the joining of components more rapidly and economically than by older, more conventional methods; (2) the production of new structural or composite units—for example, laminates such as doors, panels, table tops, and honeycomb sandwich forms; (3) the even distribution of stress to increase total strength (the construction of helicopter rotors is a prime example of this); (4) obtaining surfaces free of holes or protuberances or with unusual contours; and (5) the formation of better seals against moisture, fluids, or gases, and the ability to present a less penetrable and more corrosion-resistant surface.

The adhesives industry is one of phenomenal growth and, as such, represents an area of relatively good customer acceptance of new materials and methods. Nevertheless, it is also an industry in which technology has outstripped possible end uses. One reason for this is the lack of understanding of the advantages, in many areas, of replacing mechanical with adhesive fastening methods. Such factors as the need for better quality in products along with the lower manufacturing costs will lead more and more industries to investigate, and then use, adhesives.

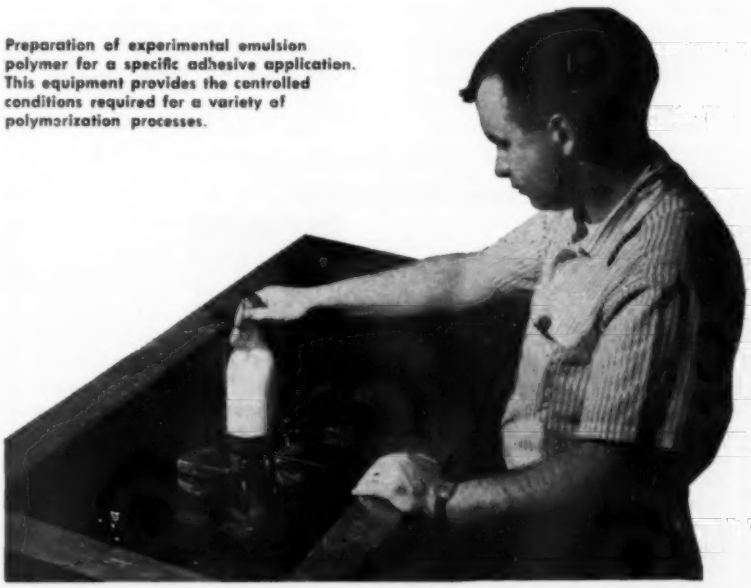
Adhesives have, on occasion, been either bypassed or replaced on the production line by more expensive and, frequently, less effective fastening methods. There are two main reasons for this. One of these is the probability that a particular adhesive has been incorrectly used and the other—a corollary to the first—is that insufficient consideration has been given to the fact that any bonding process should be considered as a total system.

The factors to be considered in defining and establishing the needs of a system are not particularly complicated when they are carefully and separately analyzed. Some of the more obvious ones are listed below, but not necessarily in the order of their importance, since the order is often determined by a particular application.

Cost and Convenience

Economics—Problems of cost are naturally important in selecting a fastening method and many factors enter into the determination of the economics of various fastening systems. To be considered when comparing adhesive and nonadhesive fastening methods are materials, degree of skill and amount of labor required, equipment, surface preparation, and space requirements. Production convenience is also a matter of importance. The speed of an adhesive system versus other methods is frequently favorable. Adhesives are readily adapted to assembly line techniques and should be considered in many instances where welding, riveting, soldering, nail and screw assembly, sewing, and other techniques of fabrication are now in use.

Properties—The function of joining two items should be defined in terms of maximum strength needs to permit the proper selection of an adhesive and to prevent under- or over-engineering the joint. Greater strength can often be obtained with adhesive systems than is possible with conventional mechanical fastenings. Extremely high strength is possible,



Preparation of experimental emulsion polymer for a specific adhesive application. This equipment provides the controlled conditions required for a variety of polymerization processes.

of course, with relatively large bonding areas. Stress loading of the finished article is also important, and if joints are loaded in "shear," or if redesign will permit this, adhesive bonds exhibit maximum performance. If the product is to be subjected to flexing, it will naturally require a flexible bond which adhesives can often supply. Also, special properties such as heat and/or water resistance can be "built" into the product by the adhesive and polymer chemist.

Surfaces—Surface characteristics of materials to be bonded can seriously influence the effectiveness of a bond. Therefore, it is important to study such factors in surfaces as their porosity, polarity, similarity or dissimilarity, heat resistance, and sensitivity to water or solvents. Proper cleaning of the surface is also important, since adhesives often fail because dirt or lubricating agents have not been removed from the products. Thus the nature of the surface involved plays a significant role in selecting the adhesive system.

Application—Adhesives can be applied by almost all coating techniques. These include brush, spray, knife coating, electrostatic deposition, dipping, and others. Also, the adaptability of the product to either hand or machine lay-up techniques can be a determining factor if a change is needed to adapt a process to making an adhesive joint. However, with the variety of adhesive materials available, different methods are usually possible in any given application, thus often making mechanical adaptation relatively simple.

Curing—Evaluating various curing or "setting" systems is usually necessary in designing a good production method. Frequently several different methods can be considered, depending on the adhesive and the product to be bonded. Dielectric heating, cold set, room temperature catalysis, solvent activation, conventional heating methods, and combinations of these can be considered. Continuous or intermittent production may impose other restrictions on the curing system. If work must be interrupted, the adhesive can be applied to the separate surfaces before assembly. The parts may be assembled at a later time by solvent or heat reactivation or, in the case of contact adhesives with residual tack, sufficient cohesive strength is often possible by applying light pressure to the joint.

End-Use Requirements

The specifications of the finished article must also be considered in selecting the adhesive best fitted for the product and the process. A product's end use, aesthetic appeal, environment and anticipated life are all important. Furthermore, the required strength and the character of the component parts of the assembly determine to a considerable extent, the adhesive requirements. For example, there is little need for using a high-temperature-resistant, extremely high-strength product to assembly relatively weak materials that will never be exposed to anything more severe than room-temperature conditions.

Perhaps a well-known type of bonding problem will illustrate the method by which an adhesive may be selected. If a heat-resistant polyester laminate is to be bonded to wood, as in the case of counter tops, cost although important, is not one of the prime considerations because of the relatively expensive materials being bonded. Adhesive bonding is certainly most convenient, if not the only possible method. Strength requirements are moderately high and, with the large surfaces involved, high strength is easily obtainable with the adhesives. The surfaces to be bonded are both porous and nonporous but both are polar in nature.

A resinous but slightly resilient high-tack material is indicated so that a resin-rubber compound represents one of the more appropriate materials. It may be applied to both surfaces from solution by any of the known techniques. Following this, the solvent may be allowed to evaporate (since one surface is nonporous) and assembly may be accomplished after drying.

The residual tack of the adhesive results in the development of high cohesive strength. Time and labor are at a minimum and hand or machine application may be used. Hazards may be kept under control since much of this is custom work.

The use of an adhesive, however, is certainly adaptable to continuous or intermittent production and, although flexibility is not important after assembly, a flexible adhesive is not subject to damage in the separate handling of the thin outer portion of the counter.

Long life and heat resistance are anticipated and the adhesive selected will supply these properties. High strength, at least equal to the weakest member, is possible and the aesthetic nature of the product is preserved. No holes are necessary, and an impenetrable surface—certainly of high importance in counter use—is provided.

The present and future utility of adhesives in the asembly and construction of extremely diverse materials has resulted in an ever-deepening probe into the theory of adhesion. In the past few years, a large number of workers have contributed valuable knowledge through their study of this phenomenon. Factors studied included cohesive strength and thickness of the bond layer, general types of surfaces, the effect of surface roughness, capillarity, and a simplified explanation of good surface contact referred to as "wetting." This latter term, indeed, has come to mean much more in reference to adhesion than it once did.

In more recent years, greater emphasis has been placed on the study of the more theoretical thermodynamic aspects of adhesion—for example, the forces of molecular attraction, primary bonds (electrostatic, covalent, and metallic), secondary bonds, (orientation, induction and

About the Authors . . .

C. W. COOPER has done work on basic adhesion problems as well as practical applications of adhesives for packaging, footwear, synthetic films, metals, and wood. Before joining Battelle he was with DuPont, where he worked on regenerated cellulose.

HERBERT JOHNSTON helped develop adhesives for corrugated board and has done research on bonding materials such as vinyl, metal, and water-resistant paper. He was formerly associated with the development of lacquers at Glidden Co.

dispersion forces), and surface activity.

The belief in the existence of mechanical adhesion, if such a condition exists at all, has given way to an explanation of good bonding action as specific adhesion. Thus, it is now recognized that surface roughening contributes to bond strength mainly because it results in a truly clean and active surface with molecular forces available to react with the adhesive.

As in other areas of research, almost as much can be learned from mechanisms of failure as can be explained by investigations of bonding action. Theoretical work is constantly contributing a better understanding of the problems involved and should eventually eliminate any need for tests that are really trial-and-error in nature.

Research Underway

Considerable work is also being done to obtain more information about established, as well as new, adhesive application methods. Studies are under way to determine the amounts of adhesive applied by various types of equipment and the effect of machine speed, machine set-up, and other factors in the quality of the product produced. Results of such studies are useful in the design of new equipment, as well as in the formulation or compounding of new adhesives. Studies of this type have been made possible by focussing the talents of various researchers, including polymer chemists, analytical chemists, physicists, and mechanical engineers, on particular areas.

It is believed that the prospect for the future growth of adhesives is at least as bright as that of the immediate past. Consider the presently available forms—curable nonvolatile fluids, adhesive films and tapes, adhesive "rods" fused as needed and heat reactable, expandable, contact, conductive, insulating, elastic, rigid, and moisture impermeable products. Several of these are available as both thermoplastic and thermosetting types.

Consider also the variety of application methods—brushing, spraying, knife coating, troweling, dipping, proportioning guns for mixing two component products in exactly correct ratios, and even electrostatic deposition for dry materials. These factors emphasize the broad base for future development.

Some of the more recent cases in which continuing growth is expected include curtain wall construction in large building trades, marine assembly, automotive (the plastic body of the Corvette is entirely bonded by adhesives), trailers, scientific instruments, cameras, optical equipment, duct work, appliances, and one of the biggest uses, packaging and labeling. Much more remains to be done. The automotive field can use increasing amounts in bonding body stiffeners, trim and ornamentation, upholstery, and other parts. The metal and plastic furniture industry can expand its utilization of adhesives.

A long period of research in bonding tin can tops, bottoms, and side seams may soon pay off. Adhesives will probably soon invade home building to a greater extent. Whole wall sections could be preformed or bonded on the job, thus eliminating costly nailing; conventional flooring could also be laid with adhesive products. Roof sections could be similarly applied.

Plumbing is another likely target. Adhesives with capillary action could be used in place of solder for copper joints and may even make way for aluminum piping. Steel piping may also become more competitive through the use of adhesive products as a substitute for conventional threading. Aluminum gutters and downspouts, already a reality, could be assembled on the job with adhesive products rather than by riveting and sealing. There is virtually no end to the fastening jobs adhesives may perform, and eventually they will be as common in these presently unusual areas as they have been for years in the furniture and cabinet industry.

Of the more unusual adhesives, single component, curable compounds are now a reality. These eliminate mixing on the job. Contact adhesives, because of their ease of assembly, are becoming more and more common. Double-faced "sheet-form" adhesives designed to bond two different types of surfaces by the application of heat are already available. Ceramic and "cermet" adhesives are filling needs in areas of extreme high temperatures.

Envisioned are products with greater specificity, improved resistance to high temperatures, weathering, water, solvents, oils, and greases. Also on the horizon are adhesives that can be used on greasy or dirty surfaces for better performance in field applications. With the properties now available and under development, almost every product can in some measure be adapted—and probably advantageously—to adhesive bonding.

Polysulfide sealant is applied to footing joint of pool with a caulking gun.

Adhesives and Sealants for Pools

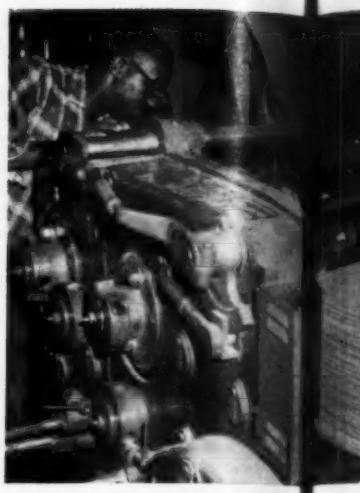
Concrete adhesives and synthetic rubber sealants now available to swimming pool owners and operators are expected to eliminate pool leakage problems and greatly reduce maintenance headaches this summer.

Made of epoxy resins and polysulfide liquid polymer—a type of synthetic rubber made by Thiokol Chemical Corp.—the concrete adhesives can be used to repair fine cracks, spalled areas and broken equipment. A coat of the adhesive is said to provide a bond that is stronger than concrete by actual laboratory tests.

Squeezed into cracks, the adhesive will render them watertight for many years. If a badly damaged area requires a considerable amount of fill material, the concrete adhesive will permit laying new concrete over the old and have it stay put for the life of the pool.

Polysulfide liquid polymer is also the base for sealants to waterproof pool expansion joints, joints between pool and terrace, and terrace expansion joints. The two-part compound can be applied with conventional caulking guns equipped with nozzles that best match the joints to be filled.

Automatic Gluer-Folder Speeds Carton Production



Baltimore carton manufacturer gets high-speed production by installing a completely automatic unit operated by a basic team of four workers

An automatic gluer-folder unit recently installed at the Penn-Mar Container Corp., Baltimore, Md., permits the company to average about 9000 boxes per hour per eight-hour shift—with up to four different set-ups. Designated commercially as a Swift Glu-Lok, the high-speed unit automatically feeds, panel scores, slots, die-cuts or prints one to four panels, glues, folds, squares and counts box blanks as they proceed to a final inspection point.

The unit requires a normal personnel complement of four people: the operator-feeder, an inspector, a bundle-tyer and a stacker.

On the production line, a feed roll conveyor brings pallet loads of corrugated box blanks to the point at which they are fed into the gluer-folder. The boxmaking end of the machine has a hopper feed which features a quick throw-off capable of lifting the stack in the hopper to cut off the flow of blanks. The machine itself continues to run until it is clear of blanks that have already entered the automatic cycle.

The main feed rolls consist of a grooved, rubber-surfaced top roll and a smooth steel bottom roll. Yoked scoring and slotting heads allow for rapid set-ups and easy adjustments. In all there are three sets of scoring and slotting heads, and a single set of combination slotting and glue-lap cutter heads.

Between the slotter shafts and the printing or die-cutting shafts is an additional set of feed rolls. The upper roll of this set is equipped with replaceable rubber inserts.

Because the box end of the machine is split so that it can be opened between the scoring section and the printing-die cutting section, set-ups can be made with a maximum of speed and convenience. The box section's front end consists of a feed table and scoring and slotting shafts. It is mounted on ways so that it may be quickly moved to the open or closed position. Open, it provides access to the adjustment controls of slotting and scoring heads. Incidentally, scrap from the slotter falls onto a lateral conveyor belt which brings it directly to the pick-up boot of an air-operated removal system.

In the glue application section of the unit, the carton's glue lap passes between a disk-type hold-down roll and a stainless steel application roll which spreads the under side of the lap. The glue roll is driven from the unit's main drive shaft through a worm-gear reduction set-up. The surface speed of the stainless steel applicator is, of course, always at the same linear speed as the box blank.

Included in the applicator roll assembly is a stainless steel wiper roll which controls application thickness. Automatic maintenance of the adhesive level in the covered aluminum glue pot is assured by a stainless steel float and control mechanism of the glue supply reservoir. Positioning and adjustment of the applicator assembly is by a screw and hand wheel arrangement. When the machine is stopped, an auxiliary motor, driving through an overriding clutch, provides for idling of the glue applicator mechanism.

When they leave the applicator section, adhesive-spread blanks are carried through the folding section on parallel rubber belts which travel over movable ways. During the folding operation, blanks are held down on the belts by rubber pressure rollers. The latter are mounted to the side frames and may be easily adjusted to accommodate board of different flute size or caliper. The Swift unit uses folding shoes and guide rods for the first 90° of fold, and rotating lazy arms to complete the last 90° of fold.

Folded and glued boxes emerge from the folding section by passing through a set of rolls. They discharge under the hold-down arm, and against a fixed squaring plate. As they settle onto the right-angle conveyor belt, a reciprocating plate jogs them against the fixed plate to insure box squareness.

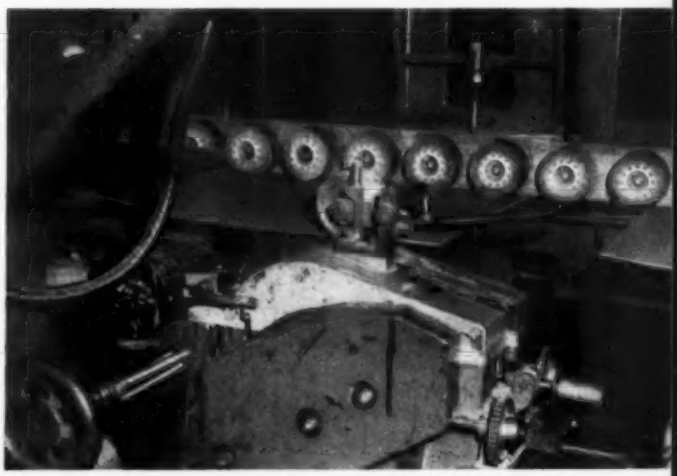
Caterpillar-type belt assemblies riding over the moving boxes provide primary compression, following which the boxes move through an electric counting unit. To completely set the glue joint, final compression is applied in a special section which consists of top and bottom roller conveyor units through which stacks are fed on powered conveyor belts. Carton stacks emerging from the compression unit continue on the bottom roller conveyor to the point at which they are tied into bundles and stacked on pallets.

Note: the Swift Glu-Lok unit is manufactured by the Metal Products Division, Koppers Co., Inc., Baltimore 3, Md.

1 Operator feeds corrugated box blanks into the scoring and slotting section of the automatic gluer-folder equipment.

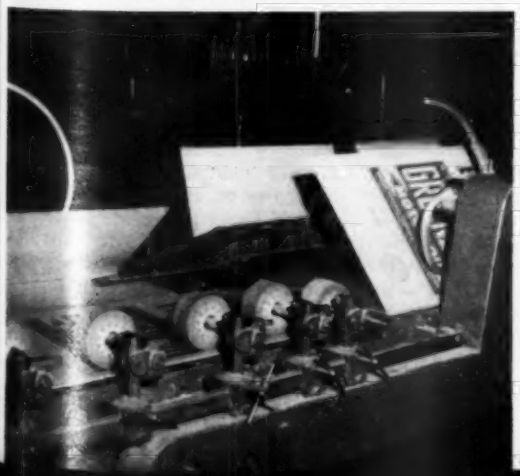
2 Conveyor installed under the slotting shafts brings scrap to pick-up boot of an air-operated scrap removal system.

3 Making set-ups quickly and conveniently is facilitated by split construction between scoring-slotting and printing shafts.

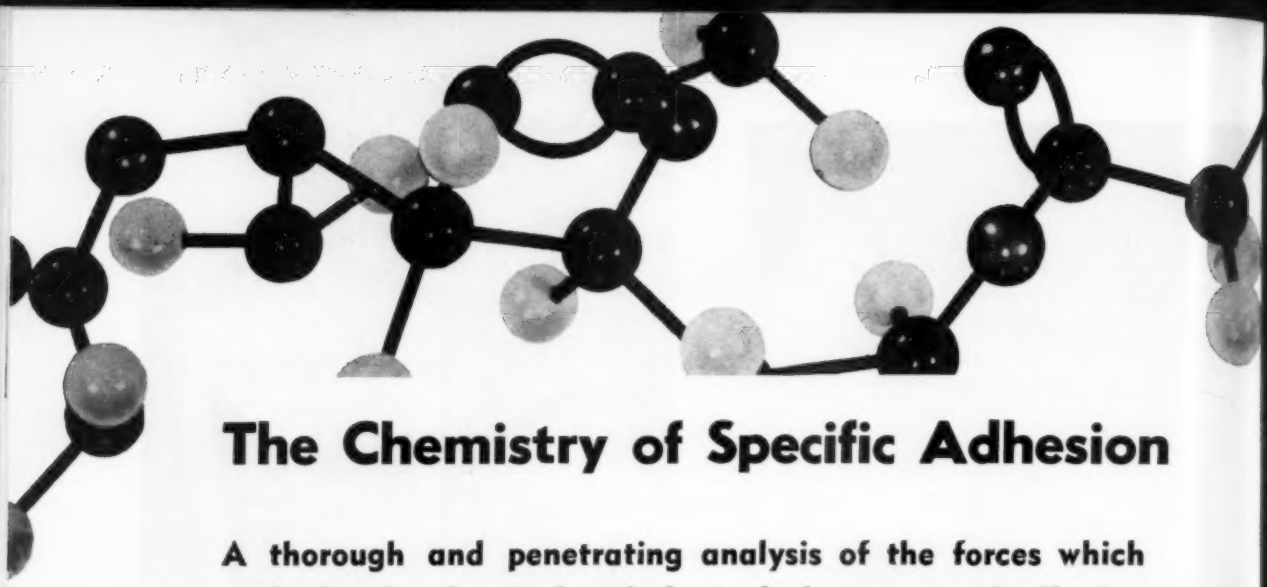


4 Adhesive is applied to the under side of the carton's glue lap as it is held down by an upper disk-type roller.

5 In the folding section, guide rods on side of movable ways can be adjusted to angle required for smooth, gradual folding.



6 Boxes which have undergone primary compression are automatically counted before being inspected.



The Chemistry of Specific Adhesion

A thorough and penetrating analysis of the forces which make for the chemical and physical phenomena of adhesion

Specific adhesion, which is utilized for the bonding of impervious surfaces such as nylon, PVC, polyurethane, cellulose plastics and glass to themselves or each other, is a phenomenon involving primary and secondary valencies. The covalent bonds which result from chemical reactions give the strongest bonds, while secondary valencies, by their very nature alone, afford bonds which are weaker although effective.

Adhesive systems can, however, be rarely defined with such precision and bonds may comprise the homopolar, heteropolar and van der Waal types. The many types of adhesion involving van der Waal forces, result from electromeric and inductive influences in the molecules at the interfaces of adherend and adhesive respectively. The electrostatic conditions ultimately set up, assist in securing adherend to adhesive.

Polar groups in which some polarization takes place, tend to give the strongest type of bond. Electromeric displacements may lead to some initial polarization in a given group and culminate in the formation of covalent bonds. An example of a covalent type of adhesion is that of the action of an isocyanate-based adhesive at a metal surface. On the surface of the metal hydrated ferrous and ferric oxide molecules are thought to exist which assist in keying the adhesive into the metal surface.

The covalent bond would constitute urethano links. The overlap of available electron pairs in the nitrogen atom with the sterically favorable electrons in the metal molecules would give additional bonding of the van der Waal type.

Saturated substances such as polyethylene in which little or no polarity exists, can after oxidation with hydrogen peroxide acquire hydroxy and hydroperoxy groups. Polyethylene may also be chlorosulfonated and the molecule given specific adhesion characteristics. The cross linking of these polymer chains with metallic oxides or polyvalent salts improves the cohesive characteristics of an adhesive system based on such a polymer.

Improving Polarity

The weak polarity of natural rubber may be improved by the use of oxidizing agents such as hydrogen peroxide, potassium permanganate and chromic acid. Dilute $KMnO_4$ tends to act at double bonds in accordance with the Baeyer Reaction to give the appropriate glycols. Such hydroxyls unless sterically hindered are capable of reacting with isocyanates. Adhesives can therefore be formulated from polyisocyanates which have free isocyanate groups available after reaction at hydroxyls.

In the bonding of rubber to metal, the rubber surface may be treated with an oxidizing agent and then a solution of a polyisocyanate modified hydroxy ester in ethyl acetate. The latter solution is sprayed on the surface of the rubber.

The non polar nature of isoprene-isobutylene copolymer is liquidated after bromination of the elastomer with N-bromohydantoin. The halogenation is carried out at 170°F.

Casein stablized latex is used as a primer in the adhesion of rubber to metal. The polar groups in the proteid molecule are responsible for the specific adhesion of the system.

The solid geometry of either the adhesive or substrate molecule is important in the ultimate establishment of bond strengths. An adhesive such as a sulfonated polyethylene usually gives bond strengths of lower values than would be expected from the number of polar groups present in the molecule. This is because the polyethylene chain has a zig-zag form, the carbons being prepared in an sp^3 hybridized state. Only half the polar groups present therefore are available at the surface of the adherend. The PVC chain follows the same rule. Adhesion at a metal surface also depends upon the distance of the metal atoms from each other and the disposition of their lattice structures.

The importance of polar groups in specific adhesion has been evaluated by the use of infrared spectra. Films of phenol formaldehyde-epoxy resins on attaining maximum bond strengths, shift their absorption maximae to the shorter wave lengths, indicating the disappearance of the primary polar groups.

Specific adhesion plays an important part in the biological processes of the living cell. Thus, for example, the attachment of an enzyme to its substrate is initially governed by the existence of secondary valency forces initiated through inductive or electromeric displacements. These take place at the enzyme-substrate interface. The hydrolysis of chymotrypsin is brought about in this way. (Formula 1)

Adhesives based on both natural and synthetic elastomers depend on

both wet and dry tack for ultimate bond development. Adequate tack times permit freedom of adjustment. At dry tack, when most of the solvents have escaped, the active masses of the ingredients in the adhesive recipe become evident and setting up of the bond starts to take place. Adhesives with a short tack time do not readily permit adjustments, and when adjustments are made at a dry tack stage, they may be made to the detriment of the developing bond.

Breaking of a bond at a dry tack stage, in specific adhesion at least, is undesirable, since the molecules have orientated themselves on the escape of solvent and secondary valencies have started to assert themselves. Most adhesive systems can be described empirically by means of a three component system as that in Figure 1.

In this system S is solvent, E is elastomer and O another important component which say can influence tack. Consider an adhesive represented by composition x. The curve ab indicates the effect of the invariant composition b on the solubility of E in S and bc that of the invariant composition on the solubility of O in S. The three triangles represent mixed phases: since T is fixed, points along the solubility curves are univariant and on cooling isothermally we arrive at the saturation curve ab.

On cooling further, *i.e.*, travelling down SY, x_1 and x_2 are reached. The composition and ratio of the solids which come out are given by the point of intersection on the conjugate lines in the triangle aEb. The chemical and physical properties of the system will then to a large extent depend upon the ratios on the conjugate lines. Thus at x_1 we have a system comprising Ex_1 parts of unvariant composition b and x_2b' parts of elastomer E. At x_2 the amount of univariant product b has increased at the expense of E since the univariant product contains more tackifier in its composition.

This means that the tackifier has an enhanced influence on the system and gives an elongated tack period. The period from x to b''' may be regarded as the wet tack period: the period from b''' to the completely solid state EyO may on the other hand be regarded as the dry tack period. These periods are particularly important in car trimming operations: in the accurate seating of upholstery material, a too quick tack time would resist accurate adjustments.

The chemical nature of a solvent system in an adhesive is an important prerequisite for successful adhesion. A solvent may attack a substrate: thus aromatic solvents attack bituminous substances and are unsuitable in adhesive formulations destined for use in securing bitumastic sound deadening materials. Blends of solvents which comprise azeotropic mixtures may give unpredictably long or short tack times. Petroleum solvents with high dry points would tend to weaken bonds made of natural rubber owing to the solvating action of the heavy ends.

The rapid evaporation of low boiling solvents, particularly those with high latent heats might tend to 'blush' and give rise to unaccountable bond failure due to minute lesions in the bond itself. The release of solvent from a polymer is related to the cohesive energy densities of solvent and elastomer respectively.

> ***". . . covalent bonds which result from chemical reactions give the strongest bonds . . ."***

In blends of polar and weakly polar solvents, the solvation of polymer by polar solvent is roughly related to the free energy of miscibility of the solvents and the free energy of solvation of polymer by solvent. If at a given temperature t, the free energy of solvation of polymer P by solvent S_1 is ΔG_1, and the free energy of miscibility of the solvents S_1 and S_2 is ΔG_2, then ΔG_2 will be greater than ΔG_1 when polymer is readily solvated by S_1. The solvation of the polar resin will be a function of the ratio $\left(\frac{\Delta G_1}{\Delta G_2}\right)$ and the tack time will be in an inverse ratio to this free energy ratio, and the greater the ratio $\left(\frac{\Delta G_1}{\Delta G_2}\right)$ the shorter will be the tack time.

If an ingredient X, say tackifier, is mixed with the polymer in a solvent S the properties of the system will be related to the free energy of solution of polymer and tackifier respectively in S. If ΔG_3 is the free energy of solution for X in S and ΔG_4 of P in S, then at a temperature t, if $\Delta G_3 > \Delta G_4$ X will tend to be insoluble in the medium and will tend to be ultimately deposited on the surface of a gelling polymer instead of being dispersed throughout its bulk. Non-uniform plasticizing effects are obtained. During the evaporation of solvents, the solvent balance may be disturbed, two liquid phases emerging. If the partition ratio of a component which is to react with a given polymer in an adhesive system is such that it is distributed more in the non-solvent for the polymer than the solvent, then faulty bonds could result.

In PVC plasticizer migration resulting from some crystallization in the PVC chains, plasticizer tends to be forced out on the gradual reorientation of the chains. The compatibility of a plasticizer will be a function to some extent of its molecular volume. Cohesive energy densities are other important factors which will vary from plasticizer to plasticizer, such a value being related to free energy changes. At the adherend-adhesive interface, the system comprises PVC-elastomer-plasticizer components.

If plasticization is regarded as a solvation process involving high boiling solvents, plasticization at the adhesive bond will depend upon the magnitudes of ΔG_5 (free energy of plasticization of PVC) and ΔG_6 (free energy of plasticization of adhesive elastomer). If $\Delta G_5 < \Delta G_6$ the effects of plasticizer migration will be at a maximum: $\Delta G_5 > \Delta G_6$ then the plasticizer will tend to solvate the elastomer of the adhesive and adversely affect bond strengths. These factors are important for adhesives utilized in the bonding of PVC to other surfaces, such as unbacked PVC leathercloth to hardboard or wood in auto doors.

Phenolic resins are included in adhesive formulations to improve specific adhesion and to improve hot bond strengths. Bonds with hot strengths are important in tropical countries and also in the manufacture of cars where an adhesive may sometimes have to stand the temperature of the touch up ovens. At ordinary temperatures, phenolic resins tend to function as fillers, particularly when compounded with natural rubber. In sulfur-cured systems, they can replace some of the sulfur, and so reduce the effects of sulfur blooming on ultimate bond strengths. Phenolic resins when used with synthetic rubbers can accelerate vulcanization and improve the sluggish cure of butadiene-styrene elastomers. At the higher temperatures, PF resins can function as cross linking agents, the higher the temperature of curing the quicker the velocity of cross linking reactions.

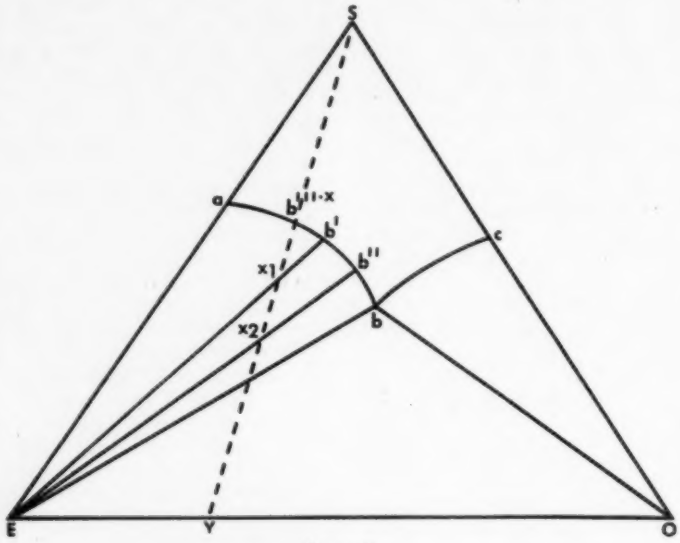


Figure 1

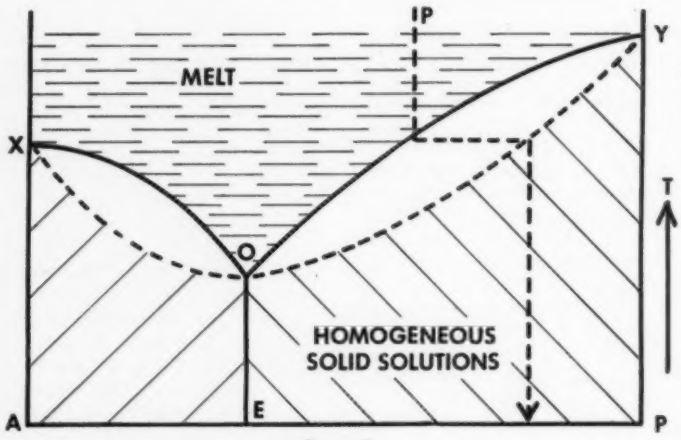


Figure 2

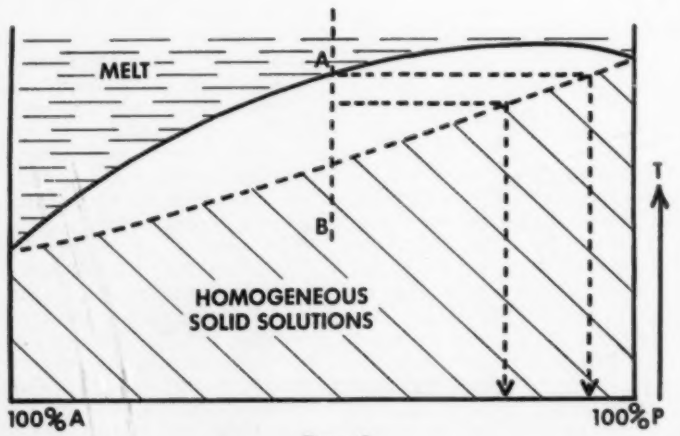


Figure 3

Many theories are extant for the cross linking mechanism. Cross linking with phenolic resins has been postulated through the intermediate quinone methines which can result from primary alcohol structures or through the disproportionation of cyclic ethers. These reactions are shown in equations (1) and (2) respectively of Formula 2.

The curing of rubber from the van der Meer hypothesis would follow as in Formula 3.

Hultzsch suggested that the quinone methines could react at olefinic centers to give pyran structures. This reaction would be competitive with the bifunctional reactions already suggested by van der Meer. Theoretically it would not give the same reinforcing effects as the van der Meer mechanism, but tend to exercise a plasticizing effect (Formula 4).

Phenolic alcohols such as 2-hydroxy-3, 5-dimethyl benzyl alcohol react with aceto acetic ester to give unstable chromanes which are converted to pyrans. This would account for the plasticizing effects of resitol structures.

Receives Support

The presence of quinone methide intermediates in curing mechanisms receives support from such reactions as the inability of phenolic ethers or O-acyl phenols to function in curing systems. Novolak resins not only act as reinforcing agents but by virtue of the chemical structure of their molecules can act as initial tackifiers because of their plasticizing effects. This is in some way related to the ability of the groups to revolve around the methylenes. The plasticity of the molecule may be reduced by the propinquity and size of the groups in the phenyl nucleus (Formula 5).

The novolaks can be cured with hexa; added cohesive strength is thus given to a system.

The reaction of phenol-formaldehyde resins in neoprene systems is possibly one in which halogen sites in the elastomer are replaced by ether structures owing to the reaction of halogen with hydroxyl. Thus 3 2p atomic orbitals in the halogen are replaced by 2 2p atomic orbitals of an ether oxygen, and we have magnetic fields in two instead of three dimensions. *Ceteris paribus* the specific adhesion would be reduced (Formula 6).

It is possible however that the phenolic resins react with the sterically less favorable groups, and therefore the reduction in specific adhesion may not be considerable.

The quick setting effect of oil soluble phenolic resins on neoprenes is possibly related with such reactions. When rearrangements reactions are used such as those involving isocyanates, the specific adhesion is less effected in view of the probable reaction of the isocyanates at the active methylene centers. The active methylenes behave as acids of low pKa (Formula 7).

The terpene phenolics and polyterpenes impart good initial characteristics. Their unsaturation characteristics permit alkylation reactions which would reduce the thixotropic characteristics of the neoprene molecule associated with halogen and methylene hydrogen atoms.

The introduction of epoxy resins into adhesive formulations improves the specific adhesion. The magnitude of specific adhesion may be appraised by the number of hydroxyls in the epoxide. The value of n in the formula below indicates the number of hydroxyls in the molecule and therefore gives some indication of the specific adhesion associated with the molecule.

The epoxy molecule unlike the polyethylene or rubber molecule does not present a regular chain form. It has sp^3 hyridized carbons linked with rectangular oxygen p orbitals which are coplanar with the attached aromatic nuclei. Many of the hydroxyl groups and epoxy groups are therefore not available for presentation at the surface of the adherend. They are however available for cross linking reactions so that adhesives of high cleavage strength and good specific adhesion may be obtained (Formula 8).

In curing mechanisms, the epoxy groups are more reactive especially with the polyfunctional amines. Since the oxirane rings are arranged at the ends of the chain, reactions involving oxirane rings and bifunctional amines will be a chain lengthening process. Trifunctional amines would however give a cross linking effect, and maximum bond strengths will not be obtained, until all the hydroxyls have reacted. The hydroxyls however react slowly so that ultimate bond strengths at ordinary temperatures may take some days before the establishment of maximum bond strengths.

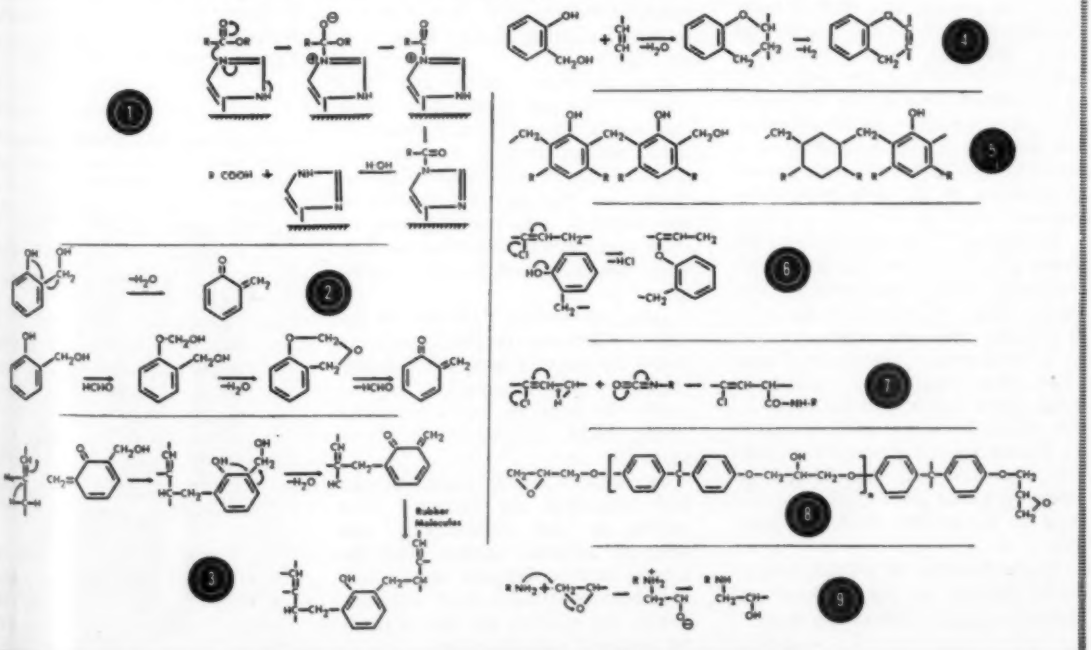
When amines are used as curing agents the rate of cure depends upon the basicity of the amine used. Aromatic amines by virtue of the resonance of the aromatic nucleus are weak bases because of the overlap of the nitrogen lone pairs with the π electrons of the aromatic nucleus.

Aliphatic amines are stronger bases since the lone pair of electrons can be used exclusively in quartenization reactions. Mechanisms involving curing probably involve nucleophilic displacements followed by migration of a proton and loss of the elements of water. Nucleophilic displacement would give trans forms and aid specific adhesion in reducing the tendency to hydrogen bonding between imino and hydroxyl groups. Cross linking reactions can also take place between hydroxyls of one chain and the substituted amino groups in a vicinal chain. The presence of bulky groups retards curing rates and di-isopropylamine gives slow reaction rates despite its aliphatic nature (Formula 9).

The presence of hydroxyl groups in the epoxy resins permits combinations with polyfunctional isocyanates. Adhesives which can be cured at room temperatures to attain maximum bond strengths 12 to 14 hours after application have been obtained from these adhesives. Cross linking is through urethano linkages. Isocyanate-based adhesives have been used for the bonding of PVC, leather and rubber to themselves or each other.

The *losungsmittelfrei* adhesives of the Germans are asolvent systems some of which comprise polyethylene and epoxy resin blends. These adhesives have been used for secur-

Reference Chart of Formulas Referred To in Text



ing of metallic, ceramic and glass surfaces. In application, the heat stable adherend is heated, but in those cases where the surfaces cannot be directly heated, infrared techniques are employed.

The mechanism of adhesion of these systems is independent of solvents, but dependent upon the dry tack of substances at their fusion temperatures. The systems may be regarded as blends of polar and non polar substances and possibly comprise either two component systems miscible in the liquid state but only partly in the solid state or systems in which the components are miscible in all proportions in both the liquid and solid states.

In the former case, the system would have a eutectic point. On cooling, a blend of composition P would give solid solutions having a high proportion of polar resin as seen from coordinates on the *solidus* curve. The melt becomes richer in the eutectic component until complete solidification is effected at the eutectic point. Initial bonding is therefore governed mainly by specific adhesion. Blends with compositions corresponding to points above the XO curve would yield adhesive systems having mechanical adhesion characteristics. In practice, blends varying from 1/1 to 1/5 of polyethylene to polyoxyethylene are used.

In Figure III where the components are miscible in all proportions in the liquid and solid states, the polar resin having the higher fusion point, the cooling of a melt of composition P' would yield a series of solid solutions, each having a greater proportion of the polar resin at the outset. This would be conducive to a specific type of adhesion, the adhesive bridge consisting of a series of solid solutions with greater proportions of the non polar component.

In Figures II and III, the area between the *solidus* and *liquidus* curves represents states equivalent to that of dry tack. On cooling from A to B (Figure III), the melt increases in its non polar content. In Figure II the melt is assured of a minimum polar resin content, determined by the ratios in the eutectic mixture. In Figure III the minimum is zero. *Ex hypothesi* the bond cleavage strengths based on Figure II would tend to be greater than in Figure III.

In the bonding of polyethylene to metal, blends of polyethylene and curable natural rubbers are used.

—*E.G.C.*

A drop of adhesive is placed on the gear shaft with a stylus. Cam end held in the upper jaws of the jig is brought into contact with the gear shaft and held a few moments.

Bonding Nylon to Nylon

Nylon to nylon adhesive bonding within seconds is speeding the assembly of a newly designed Interrupter-Timer for automatic office telephone switchboard service.

Produced by the Sessions Clock Company of Forrestville, Conn., for The A. W. Haydon Company, Waterbury, Conn., the timer performs twelve switching functions in unattended switchboards including activating flasher lights, busy tones, and bell signals.

For minimum noise and long term service the timer gears, cams and cam followers were designed in nylon plastic. Due to the complex shape of the cam shaft and associated drive gear, this part was molded in two sections. Subsequent joining of these two parts on an assembly line basis, however, proved to be a problem.

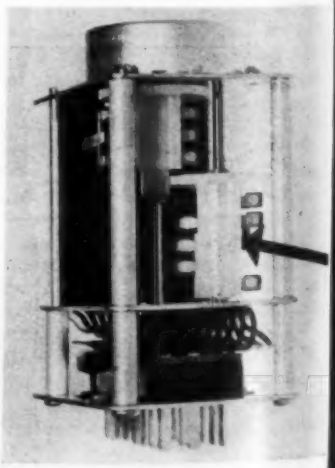
After evaluating a number of assembly methods, Haydon's engineers found the use of Eastman 910 Adhesive to be an ideal solution. Easy to apply, the adhesive forms unusually strong nylon to nylon bonds within seconds.

On Sessions' assembly line, the gear and cam shaft are mounted in a simple jig (see photograph), one drop of adhesive applied, and the mating surfaces brought into contact and held with hand lever pressure. Within ten seconds the part is ready for assembly into the timer.

Although considerably more expensive than other commercial bonding agents, Eastman 910 Adhesive has proved to be economical in this application, with approximately 6,000 bonds being formed with one half pound of the adhesive.

The adhesive, a product of Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Company, is designed to produce quick-setting, high-strength bonds between virtually any combination of materials.

An assembled Interrupter-Timer unit. The nylon cam and gear (arrow) are molded in two parts and bonded.



How to Choose an Adhesive

The adhesive selected for use in any bonding system must not only bond tenaciously to the adherends in question, but must be able to resist destructive or corrosive elements to which the end product may be exposed. It should also be the least expensive formulation consistant with quality bonding.

These factors—adhesion, resistance and cost—are rated on a 10-point scale in the guide presented below. The material was originally prepared by R. B. Seymour and R. H. Steiner for inclusion in their book "Plastics for Corrosion Resistant Applications," published by Reinhold Publishing Corp.

		Adhesion To				*Resistance To*					
Adhesive	*Cost*	*Wood*	*Metal*	*Ceramics*	*Rubber*	*Water*	*Non-polar Solvents*	*Alkalies*	*Acids*	*Fungus*	*Total*
Acrylonitrile Rubber	6	6	8	6	9	7	5	8	8	10	73
Alkyd	8	7	5	6	7	7	2	2	5	10	59
Asphalt	10	5	5	3	7	6	1	8	8	10	63
Butyl Rubber	6	3	6	2	8	8	3	10	9	10	65
Carboxy Methyl Cellulose	4	1	2	3	2	1	6	1	4	9	33
Cellulose Acetate	5	3	1	3	5	2	3	1	3	9	35
Cellulose Acetate Butyrate	4	3	1	4	5	2	3	1	3	9	35
Cellulose Nitrate	6	5	1	5	5	3	2	2	4	10	43
Chlorinated Rubber	6	5	7	4	7	6	3	10	9	10	67
Coumarone-Indene	9	5	6	3	7	8	1	10	8	10	67
Epoxy Resin	4	10	8	8	8	8	9	9	8	10	82
Ethyl Cellulose	5	3	1	3	5	2	3	3	3	9	37
Furan Resin	6	7	1	8	7	8	10	10	8	10	75
Isomerized Rubber	5	4	8	4	7	9	3	10	9	10	69
Melamine Resin	6	10	2	2	2	7	9	5	5	10	58
Methyl Cellulose	5	1	1	3	3	1	6	3	3	9	35
Natural Rubber	7	4	4	3	8	7	3	10	8	10	64
Neoprene	6	7	7	5	8	8	3	10	8	10	72
Phenolic Resin	7	8	2	6	7	8	10	7	8	10	73
Polyethylacrylate	6	4	3	5	6	8	2	5	7	10	56
Polymethyl Mathacrylate	6	3	2	3	6	8	3	8	7	10	56
Polystyrene	8	3	2	2	5	8	1	10	8	10	57
Polysulfide Rubber	5	5	4	2	4	6	8	3	5	10	52
Polyvinyl Acetal	4	7	8	7	7	8	5	3	5	10	64
Polyvinyl Acetate	8	7	7	7	3	3	3	4	6	10	74
Polyvinyl Alcohol	5	2	2	4	6	1	7	1	3	10	41
Polyvinyl Chloride	7	7	6	7	6	8	6	10	9	10	76
Saran	7	7	6	7	7	8	7	8	9	10	76
Silicone	5	6	7	7	8	10	7	6	6	10	72
Styrene Rubber	7	7	6	5	8	7	3	10	9	10	72
Unsaturated Polyester	7	8	2	5	7	7	6	1	6	10	59
Urea Resin	7	9	2	2	2	6	9	5	5	10	57
Urethane	2	10	10	9	10	7	8	4	4	10	74
Vinyl Chloride—Acetate Copolymer	7	8	6	7	5	8	5	9	9	10	74

Ratings: 1,2—Poor; 3,4—Fair; 5,6—Moderate; 7,8—Good; 9,10—Excellent

Low-Temperature Strengths of Adhesives for Metals

The National Bureau of Standards develops quantitative data on adhesive types now available for structural bonding work.

The National Bureau of Standards Boulder (Colo.) Laboratories recently investigated the low-temperature characteristics of four types of structural adhesives for the Wright Air Development Center. Tensile tests were conducted at temperatures ranging down to —424°F. with a filled epoxide, three rubber-phenolic, four vinyl-phenolic, and two epoxy-phenolic compounds. The epoxy-phenolics, both having a fiber glass supporting film, gave the best performance. The epoxide exhibited slightly less low-temperature strength, but faulty bonding apparently contributed to this behavior.

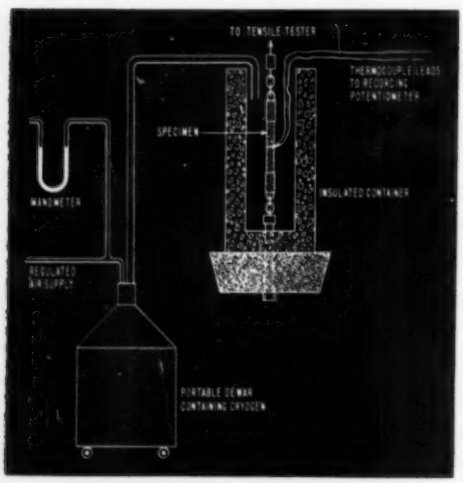
Structural adhesives for metals, first developed about 15 years ago, are expected to play an important part in the construction of future missiles and rockets that will be required to withstand a wide range of environmental conditions. These materials, having properties such as resilience, resistance to galvanic corrosion, and high strength-to-weight ratios, are particularly suitable for the assembly of the metal components used in space vehicles. In order to develop quantitative data on the low-temperature strengths of the various adhesive types now available for structural purposes, the present work was undertaken by William M. Frost of the Bureau's Cryogenic Engineering Laboratory.

Standard Specimens

The metal specimens, furnished by a commercial laboratory, were of the standard lap-shear type with a 0.5-in. overlap length. Ten lap-joint panels were fabricated by overlapping and bonding sheets of clad 2024T-3 aluminum alloy and of 301 stainless steel. The epoxy-phenolic resins were applied to the stainless steel sheets, and the other adhesives bonded the aluminum sheets. After curing, the panels were cut into 1.0 x 7.5 in. strips, and six strips from each panel were sent to the Bureau for testing.

In the tests, the specimens were gripped 2.0 in. from each edge of the lap joint and stressed at a rate of 1300 psi per minute until failure. In all cases, the bonded area was held at test temperature for at least ten minutes before load was applied with a hydraulic tensile-testing machine. The specimens were cooled to test temperatures of —107°F. and —323°F. in an insulated container that received coolant flowing from a pressurized Dewar. Thermocouples attached at the ends of the adhesive bonds were used in conjunction with a recording potentiometer to obtain temperature-time charts. Cooling to —424°F. was accomplished in two steps, precooling to —323°F. with liquid nitrogen and final cooling with liquid hydrogen.

Failures were classified respectively as adhesive or cohesive, according to whether they occurred at the interface between adhesive and adherend, or strictly within the adhesive and supporting film. Failure of the rubber-phenolics was visually verified to be completely adhesive. At each test temperature the resin tended to part from the adherend in large flakes. The vinyl-phenolics also exhibited high percentages of adhesive failure. In one sample, only small scattered particles of resin clinging to the metal prevented the failure from being 100 per cent adhesive.



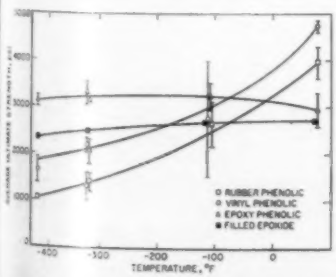
Sketch of the apparatus used at National Bureau of Standards Boulder Laboratory to cool adhesive-bonded metal specimens to temperatures as low as —424°F.

Failure of the epoxy-phenolics was predominantly cohesive, with approximately 30 per cent occurring within the thickness of the supporting glass fiber cloth. The remainder of the cohesive failure was in the rectangular spaces between strands where the resin parted from the cloth while still adhering to the metal. Adhesive failure appeared principally along the strands where pressure on the bond during cure had left a thin glue line. Upon examining these latter areas at high magnification, adhesive was found on the metal in etch pits and grain boundaries.

Inspecting Failures

Discolored regions and pitted areas attested to the inferior bonding that was generally observed with the filled epoxy specimens. In some cases as little as 70 per cent of the available area was effectively bonded. Failures appeared to be almost completely cohesive in areas where effective bonding was present, but these failures could not be classified accurately because of the discontinuous nature of the bond. Approximately 60 per cent of the specimens failed near the center of the overlap length, leaving rectangular strips of adhesive 1.0 in. by 0.25 in. on each half of the specimen

The average ultimate strengths of the four types of adhesives at −424°F were: rubber-phenolic, 1065 psi; vinyl-phenolic, 1650 psi; filled epoxide, 2345 psi; epoxy-phenolic, 3120 psi. None of these materials was formulated to withstand the particular test conditions to which it was subjected. Consequently, the results obtained do not indicate the utility of the various types for applications under normal environmental conditions. Further experimentation is indicated.



Graph of test results, showing the tendency of metal bonds to decrease in strength as temperature is lowered. Only epoxy-phenolics show a slight increase at −424°F.

▲ **A Delta maintenance man masks off the cooling muff portion of an engine cylinder with a double thickness of plastic-coated tape of the pressure-sensitive type.**

The protected engine part is placed ▶ inside a walnut-blasting chamber where it is bombarded by fine particles of walnut shell that clean off the carbon.

Pressure-Sensitive Protection

Delta Air Lines has solved a major engine cleaning problem in its maintenance headquarters in Atlanta, Ga., by using pressure-sensitive tape to speed a critical, exacting task.

The air line's engine cleaning crew is faced with the problem of cleaning all the engines that come in for overhaul at the rate of about two per day. One of the most difficult areas of the engines to clean is the cylinder, with its cooling fins and cooling muff coated by oil, dirt, grease and carbon after 1,200 to 2,000 hours of flight.

In the cleaning process the engine parts are first bathed in a solution to remove loose oil, grease and dirt particles. Then the carbon is removed by walnut-blasting. Fine particles of walnut shell are blown at high velocity over the outside and inside. However, keeping the small particles of walnut shell out of the cooling muffs posed a problem. Delta maintenance personnel tried using a metal cover, but the cover expanded and the tiny walnut particles became buried in the muff so securely that removing them was impossible.

Several Attempts

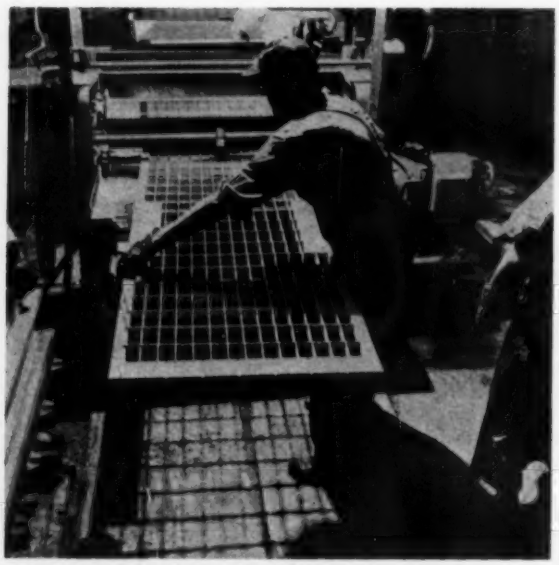
Various types of masking tapes were tried without success. They would not withstand the walnut blasting. Finally a waterproof plastic-coated cloth tape product made by Johns-Manville was used. The cooling muff was masked by wrapping the tape so that it overlapped half a width, providing double tape thickness.

The tape, designated as Dutch Brand No. 353, has an adhesion of 38 ounces per inch of width, and a tensile strength of 45 pounds per inch of width. It easily withstood the walnut blasting, and provided the answer to a tricky cleaning problem for the airline.

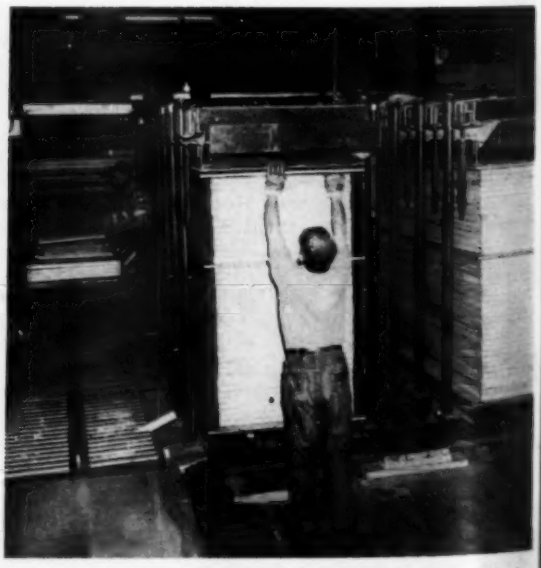
Adhesive Bonding Flush Doors

Some tips on speeding and improving the gluing operations that are necessary to prepare the veneers and frames used in making hollow-core doors

The outfeed side of a resilient-roll spreader processing door skin veneers. The man immediately behind the machine takes a double-spread center ply and lays it on top of the load. The man at the right adds two plies which become the top of one center piece and the bottom of another. Three-ply skin provides necessary non-splitting characteristics. (Photo courtesy of Black Bros. Co., Inc.)



Hollow-door cores being spread on a resilient-roll unit. Note lattice-type inner assembly. (Photo courtesy of Black Bros. Co., Inc.)



Two air-hose presses for hollow-core doors working in conjunction with spreader, left. (Photo courtesy of Black Bros. Co., Inc.)

Proper employment of adhesives is a paramount issue in manufacture of hollow-core flush doors which now dominate the market. Basically, these doors are made up of three components: a softwood inner frame, or core, and two three-ply "skins."

Adhesive is used in volume in making up the door skins. Later, the inner frames or cores are spread with a two-side machine and laid up for final pressing. Eventually, the fully-assembled doors are processed through special double-end machines which bring them to required width and trimmed length, and eliminate all overhanging veneers and other edge irregularities.

Though many variations exist in the design of hollow cores, basically six pieces of material are always involved: stiles, rails, and lock blocks.

The schematic on this page shows how these frames are generally assembled. In some cases, the two stiles (A) have a hardwood strip glued to their outer edges to match the hardwood face veneers used on the door skins. However, since the edges are never in view unless the door is standing open, this need not be done. Outer edges of rails (B) are never stripped with hardwood, because they are never seen after a door has been installed.

Two lock blocks (C) are attached to the inner edges of the stile at their mid-length to accommodate a mortised door lock. Since there is no way of knowing which of the two stiles will be used as a "lock stile" by the carpenter, lock blocks of sufficient length are set next to both stiles so that regardless of which way the door is turned during installation, there will be adequate wood volume to receive a mortised lock.

Some manufacturers make the rails somewhat wider than the stiles. There is also much variation among door manufacturers as to the manner in which the inner portion of the frame, (shown entirely open in the drawing) will be fitted with additional members to provide sufficient support for the skins.

Why Three-Ply?

Door skins are made three-ply, to give them the necessary non-splitting characteristics. The skins must be thin, so that any end grain showing in edges will be reduced to a point where it will not be noticed. Many door skins are only about ⅛ inch thick after coming from the press. Since each ply is only about ⅓ of that thickness, end grain on vertical edges of the door will be practically invisible.

Glue-spreading operations on thin, wide veneers are demanding. A resilient-roll machine must be used, and often special arrangements are necessary to avoid trouble in spreading. For example, stripper fingers are generally located at the outfeed of a glue spreader to prevent thin veneer—and especially door skins, which must be run through the spreader across the grain—from following around the lower spreader roll, wrapping around it, destroying the veneer, and making a bad mess in general.

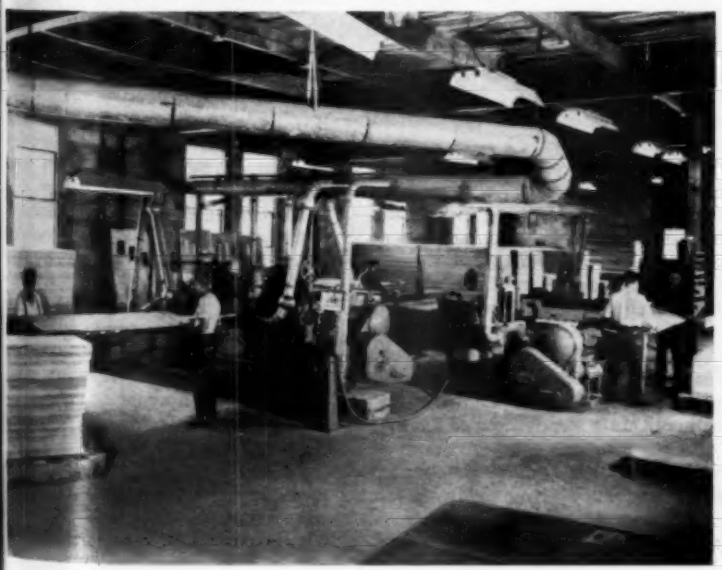
However, it is not possible to set standard stripper fingers close enough to the outfeed roll to make sure they will intercept the forward edge of such thin veneer without risking damage to the roll's rubber surface by getting them *too* close. Therefore, a special stripping wire which runs around the lower application roll of the spreader, and travels with it, is used.

When thin veneers are processed through a glue spreader, it is important to provide best possible handling advantages. Because of this, many plants install a lift of one type or another at both the spreader infeed and outfeed. This allows both the feeder and the off-bearer to keep tops of loads at a convenient level during all stages of the operation.

Door skins are often processed with heat-reactive glues, and hot-plate pressed. However, no-clamp adhesives have come into wide use for the final laminating phase. This allows the use of modern air-hose units for final pressing.

Because one side of each skin will be placed against the hollow core—where it will never be seen afterward—lower-grade veneers can consistently be used for two of the plies employed in a three-ply skin. A high-

View of large flush door factory with two double-end machines controlled from a single console seen in center foreground. Men at left are shown placing a door on feed chains of the first machine. (Photo courtesy of Greenlee Bros. & Co.)



Construction of a hollow-core frame consisting of two stiles (A), two rails (B) and two lock blocks (C). Note fasteners (D).

quality veneer will be indicated for use on the side which will be turned outward when the doors are laid up.

A resilient-roll spreader is also employed for double-spreading the hollow cores in the "laying up" operation. Flush door manufacturers have found, however, that a special type of composite grooving is used to better advantage on their spreader application rolls than the helical grooving conventionally employed. In practice, helically grooved rolls with lengthwise grooves cut directly across the helical grooves are generally used.

The lengthwise grooves are spaced about one inch apart. They allow pressure equalization on the bondant used. Adhesive tends to flow through the longitudinal grooves from points of higher to lower pressure. It is therefore believed that this type of grooving reduces "wring-off" of adhesive on the sides and trailing edges of the skeleton door frame as it passes through the machine. This makes for clearer operation and economizes on adhesive.

Where no-clamp adhesives are employed, and air-hose presses are used for final pressing of doors, use of two such presses with one glue spreader has been found particularly efficient. A layout of this type provides necessary setting time in the press.

For example, when a press load of doors has been laid up behind the glue spreader, it is run into one of the two presses, and placed under pressure. This load can then remain under pressure in press #1 until another load has been laid up and inserted in press #2, and a third load laid up ready for press #1.

Final processing of flush doors, to remove all excess glue squeeze-out around edges and to size doors in both length and width, requires large double-end machines. In plants with a limited volume of flush doors in process, one double-end machine of this type can be utilized, first setting it up for sizing a lot of doors to width, then resetting it for trimming the same doors to length.

However, in door plants where large volumes are handled, high production advantage is gained by using two machines and setting them in right-angular relationship. Doors are sized to width on the first machine, both edges being machined simultaneously. Because the second machine is located in right-angular relationship, doors automatically emerge from the first in correct position to be processed through it at a right angle.

Engineers inspect laminate failure following test with giant siren (left). Fifteen hours of testing is equal to 10,000 hours of use in an airplane.

Noise Test for Laminates

One of the biggest and noisiest sirens ever built is enabling engineers at the Convair Division of General Dynamics Corp., San Diego, Calif., to determine which of many adhesive-bonded structures have the best resistance to intense sound vibrations —the most destructive forces normally encountered by modern high-speed airplanes.

Aeronautical experts have long been aware that laminates, especially those with honeycomb cores, have exceptional ability to dampen high-frequency sound waves. But they didn't know what combinations of adhesive, core, and facing materials could be used to make laminates with the greatest durability in the presence of sounds with varied frequencies and intensities.

Convair engineers logically decided that a siren was the noisemaker they should use in getting the missing information, because sirens are among the few mechanical gadgets that can produce sounds in a wide range frequencies and intensities.

Except for its size, the siren being used by Convair is not too different from the sirens employed by fire and police vehicles. Its function is briefly to break up a steady flow of air into vibrating particles—the number of which represents a predetermined sonic frequency—by passing the air through matched perforations in a stator and revolving rotor.

Because the input air is obtainable from a 200-gallon plenum chamber, the new Convair siren can produce sounds with enough pressure or intensity to shatter high-tensile bolts and boil human blood.

Consequently, it is now possible in only 15 hours to give a laminate as much punishment as it would receive in 10,000 hours of actual use aboard an airplane.

Special microphones, strain gauges, and other instruments enable technicians to determine exactly what is going on during each test by relaying all essential data to a control room which is a safe distance away from the siren.

Work to date has not disclosed a "perfect" laminate. In fact, Convair test engineers say they can merely determine what laminates are best for certain limited applications.

However, they have confirmed something that adhesive experts have been saying for years—namely, that modern high-strength adhesives are among the least likely sources of trouble due to vibrations if they are properly employed.

Consequently, the engineers' main problem just now is to determine what core and facing materials will stand up as well—or most nearly as well—as the bonding agents that hold them together in laminates. In this connection, the fatigue resistance of core materials is important.

NEWS of the

ADHESIVES WORLD

Adhesives Industry Fights Further Tariff Reductions

Members of the adhesives industry presented their case against negotiating any more duty reductions in the chemical tariff schedule at the September Geneva, Switzerland meetings on the General Agreement on Tariffs & Trade (GATT). Over 20 witnesses from the chemical industry appeared for eight days before two government agencies, the Tariff Commission and the Committee for Reciprocity Information, arguing that rising costs in the United States, increasing imports, and the prospect of a more aggressive chemical industry developing out of the European Common Market, is putting American chemical producers in an untenable position in their home market.

"Error" in Law

Complaining that foreign glue suppliers are taking advantage of an "error" in the tariff law establishing separate duties for animal glues and gelatine NSPF (priced under 40 cents a pound) to flood the market with technical gelatine, William R. O'Connor, vice-president of Peter Cooper Corps., Gowanda, N.Y., urged that this be corrected.

Mr. O'Connor, speaking also for the National Association of Glue Manufacturers, stated that prior to the time a difference in rates for glue and gelatine existed, imports of technical gelatine were practically nil. Now imports exceed exports of animal glue. He contended that as more foreign producers become aware of the duty advantage, all imports of animal glue will be classified as technical gelatine to circumvent the higher rate of duty applicable to animal glue.

Mr. O'Connor's arguments were supported by W. G. Bangert of Stauffer Chemical Co., New York, N.Y., who warned that any reduction in tariff protection will cause or threaten serious injury to continued domestic production of animal glue by Stauffer. He said the present duties on glue have not prevented the import of substantial and increasing quantities of animal glue.

A. E. Staley, Jr., chairman of the board of A. E. Staley Mfg. Co., Decatur, Ill., informed the government trade policy makers that the United States corn starch industry has been "effectively excluded" from most foreign markets and now is rapidly losing its domestic market to imports from low-wage countries.

Appearing before the Committee for Reciprocity Information, Mr. Staley urged that no further tariff reductions be granted on foreign grain starches and that, instead, an increase in American duties on those starches be negotiated. Moreover, he pointed to tropical starches, tapioca and sago, as the most serious danger to the American industry because they are allowed to come into the United States duty free in uncontrolled amounts. Mr. Staley noted that the principal source countries, Thailand and Brazil, impose high tariffs on all starches they import.

He also called attention to the protective tariffs on starch imports established by European countries in recent years, adversely affecting American sales abroad. His testimony questioned the soundness of trade policies which invite large scale starch importations at a time when the United States farm support program has created a billion-bushel corn surplus, when the government is spending money on research for new products to alleviate the surplus, and when the corn starch industry has a capacity a third in excess of current production.

GATT meetings start this month in Geneva, but these have to do with questions arising out of the development of the European Common Market. The negotiation of new tariffs will not start until January 1961.

Celanese To Up Output

Plans to almost double its facilities at Pampa, Texas, to produce acrylate chemicals used in adhesives, paints and rubber compounds, have been announced by Celanese Corp. of America, New York, N.Y. The company reports that the new facilities will provide an added production capacity of 14 million pounds per year. Present annual capacity is 15 million pounds.

Celanese Chemical Co., a division of Celanese Corp. of America, states that among the newer acrylate chemicals it plans to make at Pampa are butyl acrylate, acrylic acid and 2-ethylhexyl acrylate. According to the company, among the uses for these newer acrylates are water-based latex paints used indoors, paper and textile coatings, and floor polishes. The company is presently making methyl acrylate and ethyl acrylate.

Not the finished adhesive, just the heart of it—the resin—is what we make.

Making an adhesive for tough jobs?

Try adding a pinch of permanence

A powerful grip—tighter than rivets—bonds the brake lining to the brake shoe.

This bond must hold fast despite sudden stops that heat up the lining; despite wheel vibration, driving rain, spattering oil and grease—through weather ranging from sub-zero cold to superhighway hot.

In millions of cars, the adhesive that does this job is made with a Durez phenolic resin.

We work closely with people who make adhesives for tough bonding jobs. We supply the pinch of permanence—the resin that gives a good adhesive its gripping power, its heat resistance, surface tack, and hardness or flexibility.

We've been specializing in phenolic resins for 39 years; have developed thousands of resin formulations; are constantly developing new ones. If there's a way we can help you solve an adhesive formulation problem, we're eager to know about it. For details on Durez resins and the service that goes with them, write us.

DUREZ PLASTICS DIVISION

8509 WALCK ROAD, NORTH TONAWANDA, N. Y.

HOOKER CHEMICAL CORPORATION

HOOKER CHEMICALS PLASTICS

Borden Names Two

Borden Chemical Co., New York, N.Y., has appointed E. Joseph Maragni assistant controller for its domestic operations, and Richard Lenz assistant controller for its international operations. Mr. Maragni joined the Borden Co. in 1947 as a senior statistical clerk. He obtained a B.A. degree in accounting and business administration from Pace College in 1951, and in 1953 was named office manager. In 1959 he received the additional duties of administrative assistant to the controller of Borden Chemical.

Mr. Lenz, formerly with the International Division of American Cyanamid Co., joined Borden Chemical in 1959 as an administrative assistant to the vice-president for international operation. In 1960 he received a B.S. degree in accounting from New York University.

Synthane Tube Winder

Installation of a special Tube Winder by Synthane Corp., Oaks, Penna., has, according to the company, resulted in major improvements in quality control and production of laminated plastic tubing. The equipment, developed by Synthane in cooperation with the Luster-Jordan Mfg. Co., Norristown, Penna., is said to permit greater exposure of impregnated filler to heating elements, to increase pressure during winding, and to improve automatic tension.

Nopco Latex Thickener

Production of a new thickener, Modicol VI, for natural and synthetic latices used in coating and adhesive applications, has been announced by Nopco Chemical Co., Newark, N. J. The thickener is a modified ammonium polyacrylate and is said to offer: excellent color and clarity, high viscosities at low concentrates, and free flow. Also, according to the company, it does not yellow or embrittle.

Announces Acrylic Acid

Dow Chemical Co., Midland, Mich., has introduced a technical grade acrylic acid at a low price. The lower prices are possible, according to Dow Badische Chemical Co., where the material is produced, by a unique method of manufacture in which acrylic acid is produced as an intermediate during the production of Dow Badische acrylic esters.

Edward W. Beardsley

Thomas A. Bruce

Appointed by Corn Products

Edward W. Beardsley has been appointed southern regional vice-president of the Industrial Division of Corn Products Sales Co., and Thomas A. Bruce has been named assistant western regional manager for the Industrial Division. Mr. Beardsley, previously assistant western regional manager, succeeds F. C. Hassman, who becomes southern regional vice-president of the Best Foods Division of Corn Products. Mr. Beardsley joined the company in 1935 and has a broad background of both technical and sales experience in the firm's industrial products. He holds a B.S. degree in chemistry from Bradley University. His headquarters will be in Atlanta, Ga.

Mr. Bruce, a graduate of Bradley University, has been associated with Corn Products for over 40 years. For the past several years he has been located in New York City in administrative positions in sales of the firm's industrial products. In moving to the West Coast to take up his new post, Mr. Bruce returns to a section of the country where he previously served as a technical sales representative in California, Oregon and Washington.

DuPont Epoxy Chemicals

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has started commercial production of pyromellitic acid (PMA) and pyromellitic dianhydride (PMDA) at its multimillion pound per year unit at its Repauno Works in Gibbstown, N.J. DuPont reports that PMDA imparts outstanding thermal stability, electrical properties, and chemical resistance to epoxy resins. It can be used in the synthesis of high temperature plasticizers, as a component of polyester and alkyd resins, and as an intermediate in the preparation of a variety of polymers, the company states. In addition, PMA can be used interchangeably in certain of these applications.

Flintkote Buys Sealzit

Flintkote Co., New York, N. Y. building products manufacturer, has bought Sealzit Company, Riverside, Calif., maker of spray gun systems and accessories. Dominic Shelton V, former Sealzit president, is retained as consultant.

FMC Names Winnicki

Henry S. Winnicki has been named vice-president of the Chemical Divisions of Food Machinery & Chemical Corp., New York, N.Y. Mr. Winnicki, formerly manager of FMC's Chemicals and Plastics Division, has been with the company since 1941.

3M Cited By FTC

Minnesota Mining & Mfg. Co., St. Paul, Minn., has been charged by the Federal Trade Commission with violation of the anti-merger law. The government's complaint alleged that competition might be damaged by a monopoly created by 3M's acquisition in 1956 of Prehler Electrical Insulation Co., Chicago, Ill., and Insulation and Wires, Inc., Fort Wayne, Ind., two large distributors of electrical insulation products.

The FTC complaint said that 3M, already the country's largest maker of electrical insulation tapes and other tapes, became the largest distributor of insulation products by its acquisition of the two companies. Because of these and earlier acquisitions, the FTC charged, 3M had acquired a dominance which might permit it to manipulate electrical insulation product prices or use other means to diminish competition.

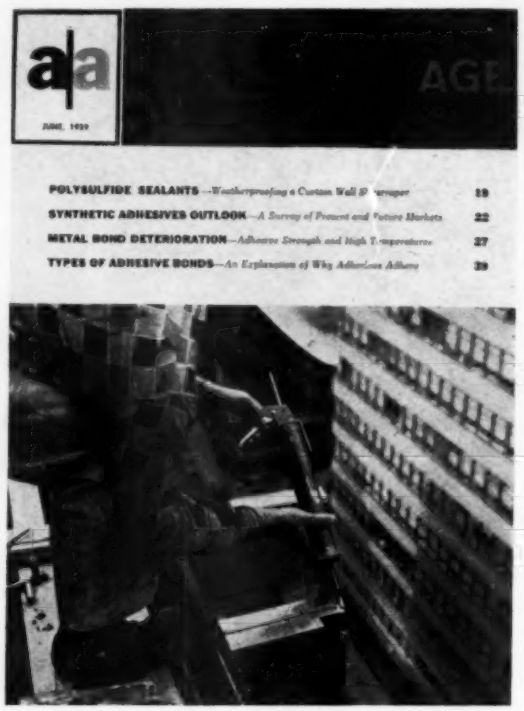
Herbert P. Buetow, president of 3M, referring to the two companies named in the FTC complaint, said: "These companies distribute a wide variety of electrical products made by a number of manufacturers."

Haveg Names Ohsol

Dr. Ernest O. Ohsol has been appointed vice-president in charge of chemical operations for Haveg Industries, Inc., Wilmington, Del. Dr. Ohsol comes to Haveg from Pittsburgh Coke & Chemical Co., where he was director of research and development. He is a graduate of City College of New York, receiving his B.S. degree in chemical engineering in 1936. He obtained his Ph.D. degree from Massachusetts Institute of Technology in 1939, and joined the Standard Oil Development Co. as a chemical engineer. In 1950, he was with the General Electric Co., as manager of its Chemical Process Division, and in 1952 he became head of the G-E new product development laboratory. Later that year he joined Pittsburgh Coke & Chemical Co.

A-D-M Sells Resin Assets

Archer-Daniels-Midland Co., Minneapolis, Minn., has sold the assets of its natural resins operations to O. G. Innes Corp., New York, N.Y. According to A-D-M, Innes, a pioneer in the marketing of these resins, will continue to service ADM customers with the same imported resins that it has supplied.



ADHESIVES AGE Photo Wins ASTM Award

An ADHESIVES AGE photograph has received an Honorable Mention Award in the General Class—Black and White—Technique category, at the 1960 Photographic Exhibit of the American Society for Testing Materials, held on June 26 to July 1, during the society's 63rd Annual Meeting in Atlantic City, N.J.

The photograph, entitled "Pressure Application of Polysulfide Seal on a Mullion," was taken by staff editor Bernard M. Berns, and appeared on the cover of the June 1959 issue of ADHESIVES AGE.

Taken at the construction site of the 52-story stainless steel and glass Union Carbide Building on Park Avenue in New York City, the photograph shows the pressure application of a polysulfide seal immediately prior to the installation of a stainless steel mullion cap. The photograph was one of a series used to illustrate the staff article "Polysulfide Sealants in Curtain Wall Construction," appearing in the issue.

Varcum Increasing Output

Varcum Chemical Division, Reichhold Chemicals, Inc., Niagara Fall, N.Y., is improving and increasing its Lindsay, Ontario, Canada, facilities for the production of phenolic molding powders. When completed in mid-1961, the facility will have a capacity in excess of 5 million pounds of phenolic molding powder annually, the company states. Reichhold reports that it is installing a new kettle at Ste. Therese, Quebec, Canada, to manufacture the complete line of phenolic resins used in Lindsay. According to the company, this equipment is expected to be on stream in September, 1960.

Urea Plants In U.S.S.R.

According to reports, three complete urea plants will soon be constructed in the Soviet Union. The plants, reportedly to be the world's largest, will be built for the U.S.S.R. by a Dutch company, Werkspoor of Amsterdam.

ADHESIVES GUIDE

by JOYCE HURD

• A Practical Handbook

designed to serve as a guide to the types of adhesives available for bonding various materials in various applications. This new British publication covers adhesives used in woodworking, bookbinding, footwear, etc., and offers valuable data on the advantages of adhesive bonding and the classification of adhesives.

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Encyclopedia of Basic Adhesive Types.

Classification of Manufacturers (British) by Basic Types of Adhesives Made

Catalog of Adhesive Manufacturers and Their Products

Trade Name Index (British)

Miscellaneous Adhesive Recipes

British Organizations Concerned With Adhesives

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FTC Charges Hooker In Phenolic Violation

Hooker Chemical Corp., Niagara Falls, N.Y., has been charged by the Federal Trade Commission with violating the anti-merger law by acquiring Durez Plastics & Chemicals, Inc., North Tonawanda, N.Y., in 1955, and certain assets of Monsanto Chemical Co., St. Louis, Mo., in 1958. The FTC complaint charges "the acquisitions may substantially lessen competition or tend to create a monopoly in the production and sales of phenolic molding materials generally and the general purpose, electrical, impact and heat resistant lines of these materials, in violation of Section 7 of the Clayton Act."

Prior to 1955, the complaint says, Hooker produced no phenolic molding compounds, but became a major factor in the industry when it obtained Durez. Durez was then the nation's largest producer of these materials with 35 per cent of the total market. Hooker subsequently increased this market share substantially, the Federal Trade Commission stated.

The FTC complaint points out that since the Durez acquisition, two significant producers have withdrawn from the industry and there have been no new entries. According to the FTC, entry is difficult because of low profitability, particularly for companies not producing the basic raw materials (phenol and formaldehyde) used in the production of phenolic molding materials, and because of the established reputation of major producers. Both Hooker and Monsanto produce phenol and formaldehyde.

The complaint alleges that Hooker acquired, for $621,000, material assets from Monsanto which included all machinery and equipment used in producing these materials, together with technical information, including formulas, know-how and engineering assistance; a list of Monsanto's current and past customers, including amounts purchased; and other assets necessary to Hooker's production and sale of Monsanto's molding materials, including the latter's promise not to produce these molding materials in the United States for 10 years.

Officials at Hooker report that they are satisfied with the purchase of the Monsanto assets, for which Monsanto had "no further use," and that the Durez acquisition was not a violation of the anti-merger law.

FMC Names Two

Food Machinery & Chemical Corp., New York, N.Y., has named Dr. Sherman K. Reed director of research for its Chemical Divisions, and Dr. John A. Garman to succeed him as research and development director of FMC's Chemicals & Plastics Division.

Dr. Reed holds a B.S. degree from the University of Illinois and a Ph.D. degree from Cornell University. He has taught chemistry at Cornell and Bucknell Universities. Dr. Reed joined FMC in 1950 and has held research positions with the Chlor-Alkali and Niagara Chemical Divisions.

Prior to his present appointment, Dr. Garman was manager of organic chemical research at FMC's Baltimore, Md., laboratory. He previously was a research chemist with U.S. Industrial Chemicals Co. at its Baltimore plant when FMC acquired this facility in 1954.

Paterson Adds Papers

Seven new saturating papers of various weights have been added to the Custom Made Paper line of the Paterson Parchment Paper Co., Bristol, Penna. All of the new papers are designed for use as base sheets for latex treated, pressure-sensitive tapes. Certain of the papers are recommended for use as: carton sealing tapes, flat masking tapes, printing tapes and protective tapes and sheeting for polished metal, wood and plastic products. The basis weight for 500 sheets, 24 inches by 36 inches, ranges from 29 to 55 pounds. Colors offered are white and brown. Sizes, in sheets and rolls, are up to 72 and 84 inches, depending on the specific paper.

Lassiter to Merge

An agreement proposing the merger of the Lassiter Corp. into Riegel Paper Corp., New York, N. Y., has been signed by the boards of directors of the two companies. Special stockholders' meetings of both companies will be held in late September to vote on the merger proposal. Under the terms of the proposed merger, Riegel would exchange .975 shares of Riegel common stock for each of the class A and B shares of Lassiter. Upon consummation of the merger Lassiter would be operated as a Riegel division, continuing under present management.

David L. Coffin

Acquires Coatings Firm

David L. Coffin, president of C. H. Dexter & Sons, Inc., Windsor Locks, Conn., has announced the acquisition of Chemical Coatings Corp., Rocky Hill, Conn. The newly-acquired firm, which will be operated as a wholly-owned subsidiary of Dexter, will continue to manufacture chemical coatings and industrial finishes under the direction of Edward H. Christ, its president and general manager. In announcing the acquisition, Mr. Coffin pointed out that the association should prove beneficial to the present customers of each firm.

Dexter, one of the oldest specialty paper mills in the country, acquired in late 1958 the Standard Insulation Co., Inc., of East Rutherford, N.J. Standard Insulation is also operated as a wholly-owned subsidiary, and specializes in the coating, lamination and impregnation of paper, fabric, glass cloth and foils.

Dexter itself has pioneered many unusual papers and webs for industrial use. In addition to natural fibers, it has been successful in processing micro glass, rayon, polyester and other synthetic fibers not commonly associated with the paper making field.

Hexcel Buys Company

Hexcel Products, Inc., Berkeley, Calif., has purchased the Applied Plastics Co. of El Segundo, Calif. Hexcel, said to be one of the biggest producers of honeycomb materials, will operate Applied Plastics as a division under the direction of F. George Firth, founder and former president of Applied Plastics, who has been named a vice-president of Hexcel. Applied Plastics produces such products as adhesives, coatings, foams and hardening systems for epoxy resin systems.

There's a reason for every Hercules® Resin

Take Neolyn 23, for Instance

The "reason" for Neolyn® 23 is its unusual molecular structure. It is a rosin-derived oil-free alkyd. As such, it combines well-known rosin-resin properties of adhesion, gloss, solubility, and compatibility with the toughness and dimensional integrity which are characteristic of a linear polyester. Thus, Neolyn 23 is useful in a variety of latex, solvent, and hot-melt adhesives . . . in filled and unfilled vinyl plastics . . . in vinyl floor tiles . . . in nitrocellulose and vinyl lacquers and printing inks for paper, foil, and metal . . . with Parlon® chlorinated rubber in specialty coatings . . . in vinyl organosols and plastisols. To these it contributes, as needed, adhesiveness, strength, gloss, pigment (and filler) wetting and bonding, flexibility, grease-resistance, heat stabilizing action, and ease of milling and processing. Can Neolyn 23 benefit you? Complete technical information and trial samples are available to help you decide.

SYNTHETICS DEPARTMENT
HERCULES POWDER COMPANY
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Metalweld Named Agent

Metalweld, Inc., Philadelphia, Penna., has been named distributor for Kabe-O-Rap corrosion resistant, reinforced plastic tanks for use in the chemical and allied industries. Metalweld's exclusive franchise for the tanks will cover New Jersey, Delaware, Maryland and eastern Pennsylvania.

The Kabe-O Rap tank consists of a fiberglass reinforced plastic tank shell which is helically wound with stainless steel cable. The tank segments, manufactured by Metal Cladding, Inc., North Tonawanda, N.Y., are bonded together at the erecting site by a cold set process, involving no flame, sparks or noise, and bonding is accomplished with the same material which comprises the tank itself.

New Lab For Eastman

Construction has started in Kingsport, Tenn., on new quarters for the sales, service and product development laboratories of the Chemicals Division of Eastman Chemical Products, Inc. The new 60,000 square foot building, scheduled for completion in early 1961, will include the following groups: plastics—basic resins, plasticizers, inhibitors and stabilizers; protective coatings—film-forming resins, solvents and modifiers; antioxidants—food-grade and industrial; functional fluids—hydraulic fluids and synthetic lubricants; low molecular weight polyolefins—polishes, textile finishes, paper coatings, and paraffin additives. Other groups planned include the study of dyes for synthetic textiles and the physical testing of products.

BRI Elects Officers

Harold L. Humes, vice-president of Baldwin-Ehret-Hill Co., has been elected to serve his second term as president of the Building Research Institute, and Robert W. Cutler, of Skidmore, Owings & Merrill, was elected to his second term as vice-president of BRI. Mr. Humes has announced a change in the BRI by-laws to permit the addition of two more vice-presidents, in order to help spread out the workload of the organization, which has increased to a substantial extent during the past 12 months. The newly-elected vice-presidents are: Graham J. Morgan, president of U.S. Gypsum Co., and Peter B. Gordon, vice-president of Wolff & Munier, Inc.

Metalweld Names Three

William R. Wright has been appointed sales manager of the Protective Coatings Division of Metalweld, Inc., Philadelphia, Penna. The appointments of William B. Wilson as general field superintendent, and John C. Adolph as office manager were announced at the same time. Mr. Wright has been associated with Metalweld for 18 years, both in production and sales.

Devcon In Canada

Devcon Corp., Danvers, Mass., has formed a company to market its products in Canada. The new firm, Devcon, Ltd., will be located in Toronto, Ontario, Canada, and will market a number of Devcon products including its Plastic Steel and Devcon rubber. According to Devcon, the new firm was formed due to the increasing demand for its products in Canada.

Glidden Building Plant

Glidden Co., Cleveland, Ohio, will start construction of a $2 million plant to produce paint, lacquer, industrial products, and eventually resin, in Carrollton, Texas, within six months. The plant, to have an initial capacity of 200,000 gallons per month, will also serve as headquarters for the company's Southwest territory.

New Metachem Division

All epoxy and other allied compounded resin products heretofore manufactured and distributed by Metachem Resins Corp., Cranston, R.I., will now be handled by the company's newly formed Mereco Products Division. Operations of the new division will be directed by A. M. Mello, present plant manager, under the supervision of H. L. Spivack, president of Metachem.

FMC Offers Catalog

A catalog of all the company's chemical products is available from Food Machinery and Chemical Corp., San Jose, Calif. Entitled "FMC Chemicals," the 36-page brochure lists the company's chemicals with physical data and uses. Available from the Chemical Division's Advertising & Publicity Department, 161 East 42nd Street, New York 17, N.Y.

J. H. Babcock Succumbs

J. Herbert Babcock, a former director and vice-president of Hooker Chemical Corp., died on July 16 at Memorial Hospital in Niagara Falls, N.Y., following an illness of three months. He was 68 years old. Well known in chemical and financial circles, Mr. Babcock had been associated with Hooker for 41 years when he retired in April 1957. He joined the firm's Niagara Falls plant in 1916 as a research chemist. Successively he had been research manager, then manager, director, and, in 1951, vice-president in charge of development and research. Mr. Babcock is survived by his wife and a daughter.

Cole Speaks In London

Gerald E. Cole, president of Kleen-Stik Products, Inc., Chicago, Ill., predicted an average annual increase in pressure-sensitive stock of 40 to 50 per cent in Great Britain for the next five years. Mr. Cole made his prediction at a recent Package Buying and Print Conference, sponsored by the London Institute of Packaging, at Eastbourne, Sussex, England. Mr. Cole's estimate, termed conservative, was made after he conferred with Great Britain's four leading producers of self-adhesive materials.

Obtains Cosden License

Under a licensing agreement with Cosden Petroleum Corp., Big Spring, Texas, Naphtachimie Company of France will be producing polybutene (polyisobutylene), a chemical specialty used to make pressure-sensitive adhesives and caulking and sealing compounds. Naphtachimie is presently constructing a plant adjacent to its ethylene, propylene and *cis*-4 facility near the French oil port of Lavéra. The company plans to extract butadiene from the *cis*-4 stream to make polybutene by the exclusive Cosden process.

Swift Completing Plant

The new $100,000 adhesives manufacturing plant, being built by Swift & Co., Chicago, Ill., at Houston, Texas, is nearing completion. The company expects production to begin by the end of September 1960. The plant will produce liquid adhesives, glues, and rubber based cements for labeling and paper firms.

India Market Available

Chemisol Industries, Bombay, India, reports that it is interested in obtaining technical collaboration with a progressive United States adhesive manufacturer for the manufacture of a full range of adhesives in India. The Indian firm is seeking collaboration with an adhesive manufacturer who can offer: technical know-how for production including recipes, patents, etc.; exploitation of registered brand names; financial participation which is optional and subject to the approval of the Government of India.

According to Chemisol, in return it would pay license fees or royalties for a specified period to be mutually agreed upon and subject to Government approval.

The Indian firm states that it is one of the progressive manufacturers of adhesives based on natural and synthetic rubber and urea-formaldehyde condensation products. In addition, it is the only organization in India solely devoted to adhesives. Chemisol feels that there exists in India a huge market for adhesives which can be captured without any competition.

Interested parties should contact Mr. H. M. Patel, Chemisol Industries, Devkaran Mansion (Grd. Fl.), 41 Princess St., Bombay 2, India.

3M Buys Revere Firm

Minnesota Mining & Mfg. Co., St. Paul, Minn., has purchased the Revere Camera Co., Chicago, Ill. Terms of the transaction were not disclosed. According to 3M, Revere's management and operating policies will continue without basic change, and Theodore S. Briskin will serve as vice-president and chief operating officer of Revere. Sam Briskin, chairman of the board of Revere, will be a consultant.

Revere is a leading supplier of movie cameras, projectors, recorders and related items. A subsidiary, Wollensak Optical Co., Rochester, N.Y., has a similar product line which is marketed through a distributor organization.

Bee Chemical Moves

Bee Chemical Co., formerly of Chicago, has moved to a newly completed plant erected by the company on a 14 acre site in Lansing, Ill., a suburb of Chicago. The 28,000 square foot building houses administrative and sales offices as well as research and manufacturing facilities of the company.

WHY DAY

MIXERS ARE **PREFERRED** BY ADHESIVES PRODUCERS:

1 *DAY builds a wide variety of process equipment for adhesives production — heavy duty dough kneading and mixing machines, high speed dispersion mixers, ribbon blenders, cylindrical mixers and cookers, change can mixers, etc. . . . in the right capacities and designs for your exact requirements.*

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At a leading producer of printed products, this DAY Jumbo Mixer prepares starch-base pastes. Mixer is of stainless steel construction, jacketed, with live steam injection pipes. Has 25 hp. drive and total capacity of 700 gal.

Here are two DAY 88 gal. total capacity Double Arm Imperial Mixers in the plant of a major rubber company. Used for processing dispersed rubber dough-type cements. Mixers have 25 hp. drives, double nobbin blades, jacketed steel construction with extra deep tanks.

Use the modern, extensive J. H. Day Co. laboratory facilities to test your products. There is no obligation.

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DAY

New Rubba Adhesive

Rubbastix, a new, non-inflammable, water-based adhesive for bonding polyethylene, polystyrene, vinyl, wood, foamed plastics, paper, fabric and other materials, has been introduced by Rubba, Inc., New York, N.Y. The new adhesive can be applied by brush, roller coater or spray and dries with a permanent aggressive tack, the company states. In addition, materials coated with the adhesive can be protected with a release paper for use at a later time, even months and years later.

Rubbastix is recommended by Rubba for the manufacture of self-sticking wall coverings, including wallpaper, plastics and fabrics; the manufacture of self-sticking displays of metal, wood, plastics and other materials; and dry flocking operations where flock, tinsel, glitter and other decorative materials can be adhered to a variety of surfaces.

Marblette Names Agent

Marblette Corp., Long Island City, N.Y., has named New London Tape Distributors, Inc., with offices and a warehouse in Niantic, Conn., to service industrial users of its plastics materials in six New England states—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

Products to be handled by New London include Marblette's E series of electrical and electronic insulating resins, comprising Maraset epoxy powders, potting compounds, dipping pastes, and varnishes, and Marafoam polyurethane foams; also Maraset epoxy adhesives and plastics tooling resins. These products fit in with other lines New London furnishes, such as electrical and electronic tapes, automotive tape, and plastic films, rods and sheets as well as tubes.

Mobay Producing Resins

Mobay Products Co., Pittsburgh, Penna., has started production of polycarbonate resins in commercial-scale quantities. Construction of plant facilities for Mobay's Merlon resins was begun last fall at New Martinsville, West Va., and trial runs began in May 1960. According to Mobay, this is the first commercial-scale production of polycarbonate resins in the United States.

Fasson Names Two

Robert G. Hamilton has been appointed to the newly-created post of market development manager for Fasson Products, Painesville, Ohio, and William H. Burke has been named decorative products specialist. Mr. Hamilton will be responsible for coordinating research and development of new products, and establishing new markets for Fasson. He previously was industrial products sales manager, and prior to joining Fasson had been associated with Wurlitzer Co., and Sylvania Electric Co. Mr. Burke, formerly assistant industrial products sales manager for Fasson, will be responsible for expanding sales activities for Fasson decorative products in the industrial field.

Resins Plant On Stream

The new synthetic resins plant of American Alkyd Industries has gone on stream at Richmond, Calif. Estimated capacity of the new facility is 26 million pounds of resins a year. The company plans to produce its regular resin line of alkyd, polyesters, phenolics, hard maleics, polyvinyl acetate, and acrylic emulsions.

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Trowellable for sealing cracks in walls, concrete pipe, gelcoating of molds and patterns, gloss coating, sheet metal bonding and sealing

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Glass cloth lamination, impregnation of felt and concrete, reinforcement of glass for sheet metal repair, fabrication of ductwork, chemical storage tank lining

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Aluminum or steel paste for metal repair, sealing of seams, wire rope terminal potting, bonding metal to metal, body work, mounting bolt grouting, filling porous castings

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Borden Hits High Mark

Sales and earnings of the Borden Co., New York, N.Y., for both the quarter and half-year ended June 30 were at all-time highs. For the first six-months of 1960, net income was $13,394,158, an increase of 12.2 per cent from the 1959 figure of $11,932,906. Earnings per share were $1.35 compared to $1.23 a year earlier. The 1959 figures are adjusted for the two-for-one stock split effective January 5, 1960. First-half sales were $471,487,360, an increase of 3.3 per cent from $456,453,156 in the first half of 1959.

Second quarter earnings in 1960 were $7,948,540, up 7.3 per cent from the year-ago figure of $7,407,084. Sales for the 1960 period were $241,474,365, compared with $235,808,410 in the second quarter of 1959, a gain of 2.4 per cent. Earnings per share in the period were 80¢, compared with 76¢ in the 1959 second quarter, adjusted for the two-for-one stock split.

Flintkote Gypsum Deposit

Flintkote Co., New York, N.Y., has acquired from the Province of Newfoundland, Canada, 99-year rights to large deposits of gypsum. George Pecaro, president of Flintkote, reports that the company will take over the operation of Atlantic Gypsum Co., at Corner Brook in Newfoundland, and will have rights to deposits in 3,000 square miles of Newfoundland territory with reserves said to consist of at least 200 million tons of gypsum.

According to Mr. Pecaro, a plant to process the Newfoundland gypsum rock will be built in the New York City metropolitan area to serve the eastern United States. The Atlantic Co. in Newfoundland will serve eastern Canada via the St. Lawrence Seaway.

New Roll Label Officers

The Roll Label Manufacturers Association, Washington, D.C., elected new officers at its recent annual meeting in Chicago, Ill. The newly-elected officers are: *President,* T. J. Norman (Package Products); *Executive Director,* John A. Bresnahan; *Vice-President,* A. M. Steigerwald (A. M. Steigerwald); *Treasurer,* W. Wallace Muir (Grand Rapids Label).

The Fall-Winter meeting of the Roll Label Manufacturers Association will be held on November 16 to 18 at the Desert Inn, Las Vegas, Nev.

Plastics-Paper Meeting

Nineteen papers are scheduled to be given as part of the technical program at the 15th Plastics-Paper Conference of the Technical Association of the Pulp and Paper Industry, to be held on October 16 to 19 at the Hotel Syracuse, Syracuse, N.Y. The conference is being sponsored by the TAPPI Converting and Consuming Division, which includes the Plastics, Plastics Laminates, and Wet Strength and Interfiber Bonding Committees of the association.

The general conference chairman is V. T. Stannett (Syracuse College of Forestry). The technical program chairman for this meeting is R. W. Loheed (Chas. T. Main, Inc.), and C. G. Morse (Sealright-Oswego Falls Corp.) is the chairman in charge of local arrangements.

Gunderson Named

Norman H. Gunderson has been named manager of the Mid-States Gummed Paper Division, Minnesota Mining & Mfg., Co., Bedford Park, Ill., succeeding W. G. Bretson who has been promoted to a new assignment with 3M in St. Paul. Mr. Gunderson joined 3M in 1947 as a tape salesman at its Chicago branch. In 1951 he was an industrial trades sales supervisor, and since 1952 had been Chicago branch division sales manager. Mr. Bretson, whose new duties will be announced at a later date, will continue to serve as a consultant to the Mid-States Division.

National Starch Finances

Net sales of $27,483,585 were reported by National Starch & Chemical Corp., New York, N.Y., for the six-month period ended June 30. Sales for the same 1959 period were $25,934,001. The firm's net income after taxes for the 1960 half amounted to $1,591,215, equal to common share earnings of 78¢, compared with $1,550,764, or 76¢ per share for the like period of 1959.

M&C Income Up

Minerals & Chemicals Corp. of America, Menlo Park, N.J. has announced that its net income for the six-month period ended June 30, amounted to $1,357,843, or 66¢ per share of common stock, compared with $1,550,764, or 60¢ per share for the same 1959 period. Net sales for the first six months of 1960 totaled $9,849,208, compared with the 1959 figure of $9,080,222.

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Lefkoweld Adhesives are used in industry for structural assembly, repair, maintenance and modification. They maintain full strength under varying temperatures, are completely solvent-free, and are easily handled on complex contours. They resist corrosion, vibration, oil, moisture, gasoline, hydraulic fluid.

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AVAILABLE IN DISPOSABLE KIT

Lefkoweld 2-Component Paste Type Adhesive (Type 109) is also now available in handy, disposable, high-grade polyethylene kits as well as in cans and drums. The Lefkoweld is accurately pre-proportioned for you in the kit form. The kit provides for clean, accurate blending of adhesive and activator.

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Lefkoweld formulations are ideal for assembly, maintenance and repair. Technical data and recommendations on request.

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INDUSTRIAL DIVISION

Snyder Named Manager

E. Carl Snyder has been named manager of sales-service for the Industrial Division of Corn Products Sales Co., New York, N.Y. He succeeds Thomas A. Bruce, who has been assigned to the West Coast area as assistant western regional manager of the Industrial Division. Mr. Snyder, a graduate of Renssalaer Polytechnic Institute with a degree in chemistry, joined Corn Products in 1946 in the Research Department. In 1954 he served in the Technical Service Department, and later became assistant manager.

Container Sales Up

Consolidated sales of $158,127,000 for the six months ended June 30, compared to $155,896,000 for the same period last year, were reported by Container Corp. of America, Chicago, Ill. First half consolidated net earnings for 1960 were $9,896,000, against $9,625,000 for the like 1959 period. Net earnings per share of common stock for the first six months of 1960 were 92¢, compared with 90¢ for the same period of time in 1959.

Pardon Us

In the August 1960 issue of ADHESIVES AGE, the caption for the photograph of ASTM Committee C-24 on Joint Sealants identified H. Lipkind, secretary of Subcommittee 1 on Nomenclature, as being associated with L. Sonneborn Co. Mr. Lipkind left Sonneborn in March 1960, and has been with Avadan Corp., Nutley, N.J., since that time.

Develops Vinylstix

Vinylstix Heat Seal, a new, water-based adhesive for dry-bonding supported and unsupported plastics, cotton, wool, leather, paper, acetate and other materials, has been developed by Adhesive Products Corp., New York, N.Y. According to the company, materials coated with Vinylstix Heat Seal may be stacked and die-cut when the adhesive dries for bonding, immediately or at a later date. A clean, strong, permanently-flexible bond to almost any surface can be obtained instantaneously, merely by applying heat, the company states.

Colton Develops Vinac

Colton Chemical Co., Cleveland, Ohio, has developed a new emulsion, designated Vinac AA-63, for adhesives compounding. According to the company Vinac AA-63 is compatible with solutions of fully hydrolyzed polyvinyl alcohol. The non-creaming properties of the new emulsion are said to prevent fully hydrolyzed PVA solutions from separating upon aging and also to impart more water resistance to finished adhesives. Colton states that other characteristics of Vinac AA-63 are: normal compounding with solvents and conventional plasticizers; excellent mechanical stability; low viscosity index; and good machining properties.

Staley Names Breyfogle

Paul L. Breyfogle has been promoted from assistant superintendent to superintendent of the dry starch section of A. E. Staley Mfg. Co., Decatur, Ill. Mr. Breyfogle was formerly with B. F. Goodrich Co., Akron, Ohio, and joined Staley as a chemical engineer in 1947. He succeeds Frank J. Rogier, who is retiring after 35 years with Staley.

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If your problem is high speed coating of paint, varnish, glue, latex, etc. — POTDEVIN's sixty years of specialization in coating equipment can quickly help you solve it . . . guaranteeing initial low cost and top efficiency. Illustrated is just one of hundreds of special machines. It laminates rolls of materials up to 20" wide at speeds up to 50 feet per minute.

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Holloway Plasticizers

Holloway Sucro-Chemicals Corp., Maspeth, L.I., N.Y., has developed several new products for use as insolubilizer-plasticizers with polyvinyl alcohol and polyvinyl acetate. Called Hollesters, the materials are liquid, modified and stabilized sugar esters and derivatives. The company claims that Hollesters have excellent color and heat stability and have the ability to insolubilize polyvinyl alcohol in such compounds as emulsion type paints, coatings and polyvinyl alcohol films.

Suggested applications for Hollesters include: heat set printing inks; wet strength paper; coating for paper with and without pigments; coating for wood, metals and other building materials; binder for molding sands; moisture barrier in cardboard: adhesives such as polyvinyl acetate; for greater moisture resistance in waxed paper; to overcome moisture sensitivity of PVA in many of these products; and helpful to produce PVA for extruded gasoline hose.

Naugatile Distributor

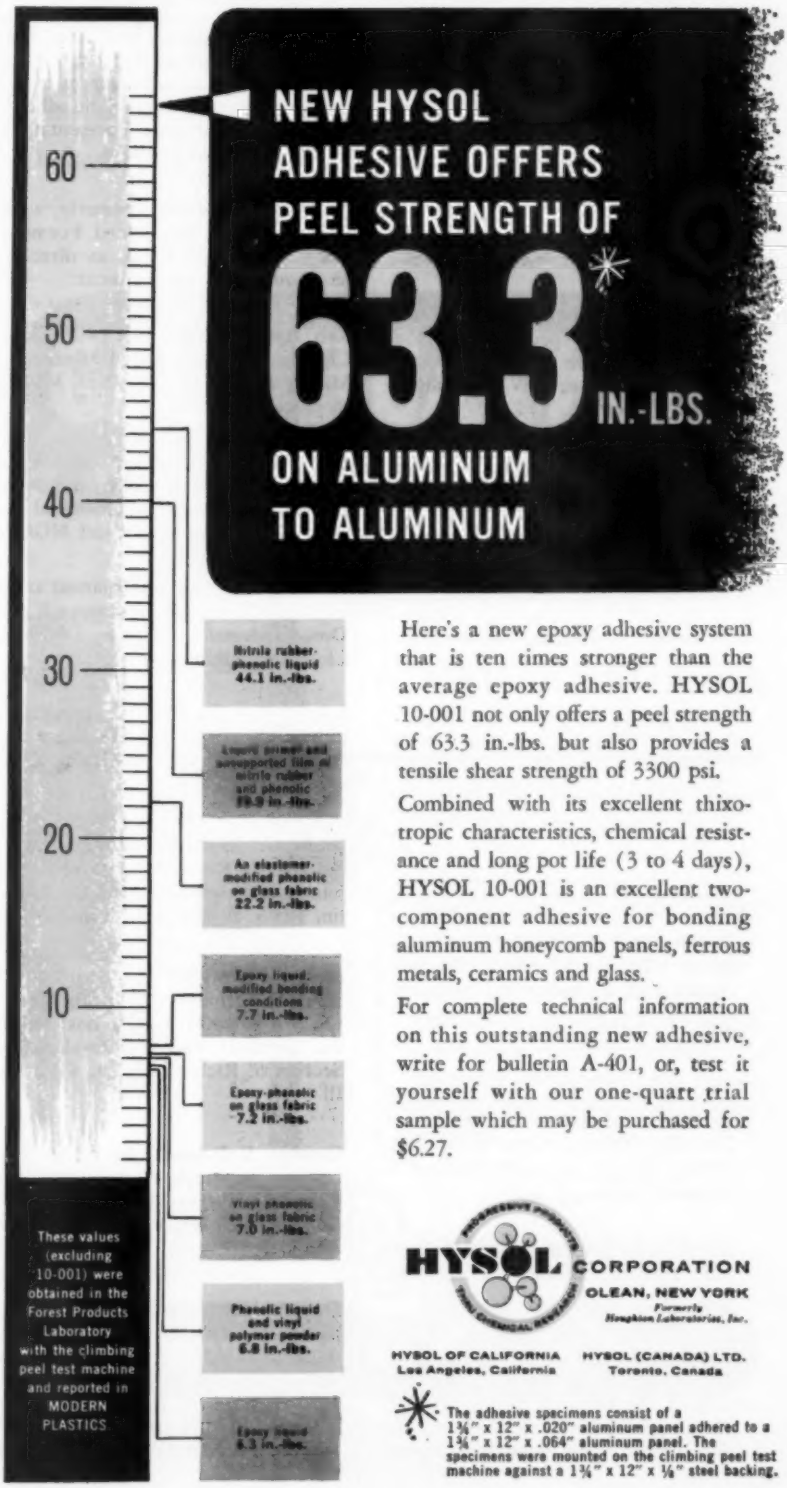
Poly-Chem Materials Corp., a newly-formed subsidiary of Industro Transistor Corp., Long Island City, N.Y., has been appointed the national distributor for Naugatile, the new architectural coating developed by the Naugatuck Chemical Division of United States Rubber Co. The company is now setting up a nation-wide network of franchised dealers in the paint and coating industries.

Naugatile is a polyester-based liquid that can be applied by spray or brush to cement blocks, concrete and other masonry walls. It can be pigmented in a variety of colors and gives walls a permanent tile-like decorative surface which is resistant to both water and chemicals.

Packaging Forum Program

Over 50 nationally recognized packaging experts will present professional papers as well as their professional forecasts at the 22nd Annual National Packaging Forum, sponsored by the Packaging Institute, on October 31 to November 2 at the Statler-Hilton Hotel in New York City. Ten sessions are scheduled covering such subjects as: packaging for self-service; packaging research and development; corrugated and fiberboard materials; drug and pharmaceutical; production line and machinery; printing; flexible packaging and plastics; food; closure; and petroleum packaging.

. . . and they said this couldn't be done!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NEW HYSOL ADHESIVE OFFERS PEEL STRENGTH OF
63.3* IN.-LBS.
ON ALUMINUM TO ALUMINUM
Nitrile rubber-phenolic liquid 44.1 in.-lbs.
An elastomer-modified phenolic on glass fabric 22.2 in.-lbs.
Epoxy liquid, modified bonding conditions 7.7 in.-lbs.
Epoxy-phenolic on glass fabric 7.2 in.-lbs.
Vinyl phenolic on glass fabric 7.0 in.-lbs.
Phenolic liquid and vinyl polymer powder 6.8 in.-lbs.
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These values (excluding 10-001) were obtained in the Forest Products Laboratory with the climbing peel test machine and reported in MODERN PLASTICS.

Here's a new epoxy adhesive system that is ten times stronger than the average epoxy adhesive. HYSOL 10-001 not only offers a peel strength of 63.3 in.-lbs. but also provides a tensile shear strength of 3300 psi.

Combined with its excellent thixotropic characteristics, chemical resistance and long pot life (3 to 4 days), HYSOL 10-001 is an excellent two-component adhesive for bonding aluminum honeycomb panels, ferrous metals, ceramics and glass.

For complete technical information on this outstanding new adhesive, write for bulletin A-401, or, test it yourself with our one-quart trial sample which may be purchased for $6.27.

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* The adhesive specimens consist of a 1⅜" x 12" x .020" aluminum panel adhered to a 1⅜" x 12" x .064" aluminum panel. The specimens were mounted on the climbing peel test machine against a 1¾" x 12" x ¼" steel backing.

names in the news

George Appunn, formerly with Carr-Liggett Advertising, Inc., has been appointed advertising manager for Fasson Products, Painesville, Ohio.

Fred W. Walworth has been appointed Chicago regional sales manager of commodity oils for Archer-Daniels - Midland. He succeeds **Thomas A. Proctor,** who has retired.

Wes Hall, of Glulam Products, Ltd., has been elected president of the Canadian Institute of Timber Construction. He succeeds **W. K. Nichols,** Timber Preservers, Ltd.

Dr. Theodore W. Evans, vice-president for research for Shell Development Co., Emeryville, Calif., has been honored by the company upon completion of 30 years of service.

Dr. Robert C. Putnam has been appointed chief chemist at U.S. Testing Co., Hoboken, N.J.

E. Glenn Clackum, previously with Foster Grant Co., has joined Shell Chemical Co., Wallingford, Conn., as senior color specialist for the Plastics and Resins Division.

Ellsworth E. Kimmel has been named director of the Industrial Market Development Department of A.E. Staley Mfg. Co., Decatur, Ill., and **Constantine J. Ballos** has been appointed head of the Paper Industry Section of that department.

John L. Burton has been appointed supervisor of technical service in Toronto, Ontario, Canada, for National Starch & Chemical Co. (Canada), Ltd.

Dr. John R. Nazy has joined the central research laboratories of General Mills, Minneapolis, Minn., as project leader in polymer research.

Dr. Walter K. Henle has joined the staff at the research center of Shell Development Co., Emeryville, Calif., as a chemist in the Analytical Department.

William L. Spliethoff has joined the Chemical Division of General Mills, Kankakee, Ill., as manager of market research, and **Ronald Sundberg** has been named sales representative for the Chemical Division.

Dr. John F. Nobis, formerly with Armour & Co., has joined Formica Corp., Cincinatti, Ohio, as director of commercial development.

Ken Rykken, previously with Dow Chemical Co., has joined Minnesota Mining & Mfg. Co., St. Paul, Minn., as process engineer.

Peter Grace, president of W.R. Grace & Co., New York., has been named chairman of the chemical industry committee of Project HOPE.

W. B. Brown has been named sales manager of the products branch for Dow Industrial Service Division, Cleveland, Ohio.

John J. Paredes has been appointed midwest regional sales manager for Geigy Industrial Chemicals Division, Chicago, Ill.

John G. Willard, formerly with Southwest Research Institute, has joined Jefferson Chemical Co., Austin, Texas, as senior research chemist.

Meir Weinstein, previously with Serafon Resinous Chemicals Corp., Ltd., Rehovoth, Israel, has joined the Molded Products Development Section of Richardson Co., Chicago, Ill.

George Kollmann, formerly with Dunlop Research Center, Toronto, Canada, has joined Borden Chemical Co., Philadelphia, Penn., as research chemist.

Dr. Andrew Dravnieks has been named scientific adviser in chemistry research at Armour Research Foundation, Chicago, Ill., and **Dr. Richard Ehrlich,** has been appointed assistant director of life sciences research for the foundation's Chemistry Division

Joins General Mills

Stanley W. Cairns has been appointed a sales representative for the Chemical Division of General Mills, Minneapolis, Minn. He will be located at the division's sales and service office in Philadelphia, Penna. Mr. Cairns' territory will include Pennsylvania, Delaware and Maryland, and he will be responsible for the sale of General Mills Versamid polyamide resins, GenEpoxy resins, Genamid liquid co-reactants, fatty nitrogen chemicals, and other chemical specialty products. Mr. Cairns previously was with Jefferson Chemical Co. He holds a B.S. degree in chemical engineering from Princeton University.

Furane Adds To Lab Staff

Furane Plastics, Inc., Los Angeles, Calif., has given new assignments to three of its laboratory personnel. Ken Cressy will supervise product development of building trades materials, as well as the electrical product line for which he has been responsible in the past. David Rose has been added to Mr. Cressy's staff as a chemist who will concentrate upon new epoxy and urethane material applications. Paul Meadows has been assigned to the Research Division of Furane's laboratory as an organic chemist working on urethane resin polymers.

Moore Takes SPI Office

Samuel A. Moore, new general chairman of the Reinforced Plastics Division of the Society of the Plastics Industry, Inc., has begun his two year term of office. He is manager of the Commercial Resins Department of the Finishes Division of the Interchemical Corp., Cincinnati, Ohio, and has been active in the reinforced plastics area of the plastics industry for 17 years. Mr. Moore has been Midwestern chairman of the Division and has served on a number of Divisional committees.

Pee Cee Names Four

Don Gevirtz has been named general manager of the three divisions of Pee Cee Tape & Label Co. with plants in Los Angeles, Calif., St. Louis, Mo., and Dumont, N. J. Norman Hall has been appointed Eastern operations manager; Robert Buckley, general sales manager; and Charles Richardson, product manager.

Adhesive Council Officers Nominated

A slate of officers to head the Rubber & Plastic Adhesive & Sealant Manufacturers Council in 1961 was recommended by the Steering Committee during the council meeting on June 15 to 17 at the Broadmoor Hotel in Colorado Springs, Colo. The Steering Committee recommended the following slate for consideration and vote at the Adhesive Council meeting on September 29 and 30.

President, B. F. Warmer (Coast Pro-Seal); *First Vice-President,* J. W. Brush, Jr. (Raybestos-Manhattan); *Second Vice-President,* D. G. Williamson (Williamson Adhesives); *Third Vice-President,* R. E. Smith (H. B. Fuller); *Treasurer,* F. M. Jeffe (Pierce & Stevens). In addition, H. L. Dixon (B. F. Goodrich) and H. Wesley Hibbert (Pecora) were named to complete the Steering Committee, which includes the five officers, and to represent the general membership at large. Raymond J. Vonesh is executive secretary for the council, with headquarters in Chicago, Ill.

FPL 50 Years Old

The U.S. Forest Products Laboratory, Madison, Wisc., celebrated the 50th aniversary of its founding on June 2 to 4 with three days of ceremonies in Madison. Representatives from laboratories, industry, schools, and government agencies attended and participated in the celebration activities, which included a banquet on June 2, a general assembly and a guest tour of the laboratory on June 3, and a public tour of the laboratory on June 4.

Frederick K. Weyerhaeuser, chairman of the board of Weyerhaeuser Co., in an address before the general assembly on June 3, stated that lumber's markets have been shrinking as much because of newer wood products as because of other competing materials. Mr. Weyerhaeuser hailed the developing use of adhesives in wood products as perhaps the most important single development in the lumber industry today.

Polymer Building Plant

Polymer Corp., Reading, Penna., has started construction of a plant in Chicago, Ill., for the plastic coating of metal products. The plant, according to Polymer, will have facilities for applying vinyls, cellulosics, epoxies, nylon and other resins to metals. The facility is expected to go on stream in November 1960.

Building Resins Plant

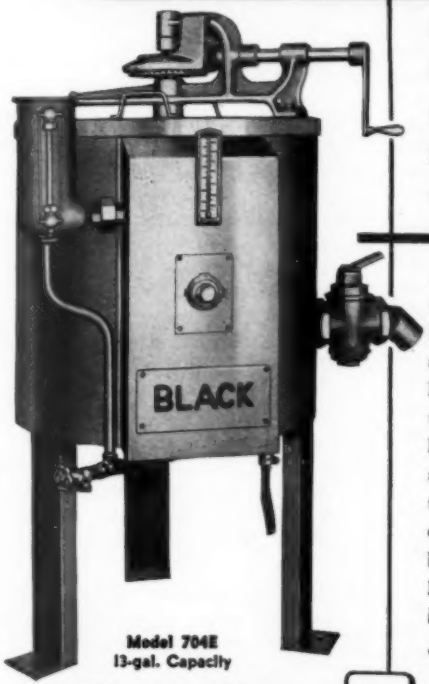
American Alkyd Industries, Carlstadt, N.J., has purchased a 10 acre tract of land at Carpentersville, Ill., to build a synthetic resins plant. The new plant, the firm's third in the United States for the production of synthetic resins, is scheduled to be on stream in the last quarter of 1960 and will produce polyester resins for the plastics industry and other synthetic resins for use in paint and varnish, the company states. The other plants are in Carlstadt, N.J., and San Francisco, Calif.

Changes Name To DAP

Dicks - Armstrong - Pontius, Inc., Dayton, Ohio, has changed its corporate name to DAP, Inc. Since 1957 the company has manufactured DAP brand putties and caulking-glazing-sealing compounds. According to John N. Dicks, president of DAP, the firm's long range plan had been to change the company name to DAP, Inc., as soon as the DAP brand name had been thoroughly established at both the consumer and trade levels. The firm has nine plants in the United States.

GLUE HEATERS

by Black Brothers



Model 704E
13-gal. Capacity

In addition to the Series 700, Blacks have a complete line of simple glue heaters, continuous glue preparers, portable pot glue heaters, and contact heaters.

FOR THE PREPARATION OF GLUES AND SIMILAR MATERIALS REQUIRING HEAT

Available in a complete range of sizes from 2½ to 125 gallons or larger, Black's Series 700 Heaters can be arranged for steam, electric or gas heat. They are of the water jacketed type and doubly insulated against heat loss. The liquid heating medium allows rapid and controlled heat transfer — without danger of localized over-heating. Corrosion resistant, boiler-like construction — will last a life time. Either power or hand stirrers available.

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Aug. 29-Sept. 2. Gordon Research Conferences, Adhesion, New Hampton School, New Hampton, N.H.

Aug. 29-Sept. 10. World Forestry Congress, Seattle, Wash.

Sept. 6-9. Canadian Pulp and Paper Association, Technical Section, Summer Meeting, Banff, Alberta, Canada.

Sept. 8-20. International Aviation & Air Industries Exposition, Waldorf-Astoria Hotel, New York, N.Y.

Sept. 10-17. Fifth International Instrument and Measurements Exhibition and Conference, Stockholm, Sweden.

Sept. 11-14. Produce Packaging Exposition, American Hotel, Miami Beach, Fla.

Sept. 13-15. American Chemical Society, New York Section, Chemical Exposition, Hotel Statler, New York, N.Y.

Sept. 14. Packaging Institute, Professional Member Seminar on Folding Cartons, Drake Hotel, Chicago, Ill.

Sept. 15-16. Armed Forces Chemical Association, 15th Annual Meeting, Sheraton-Park Hotel, Washington, D.C.

Sept. 21-23. American Management Association, Workshop on Packaging Costs and Controls, Hotel Astor, New York, N.Y.

Sept. 25-28. American Institute of Chemical Engineers, Fall Meeting, Mayo Hotel, Tulsa, Okla.

Sept. 26-28. Standards Engineers Society, 9th National Convention, Pittsburgh Hilton Hotel, Pittsburgh, Penna.

Sept. 27-29. Technical Association of the Pulp and Paper Industry, 11th Testing Conference, Pantlind Hotel, Grand Rapids, Mich.

Sept. 28. Packaging Institute, Professional Member Seminar On Resins and Packaging Applications, Statler Hilton Hotel, New York, N.Y.

Sept. 29-30. Rubber & Plastic Adhesive & Sealant Manufacturers Council, Fall Meeting, Lake Shore Hotel, Cleveland, Ohio.

Oct. 5-7. Hardwood Plywood Institute, Annual Fall Meeting, Dinkler Plaza Hotel, Atlanta, Ga.

Oct. 9-12. American Society of Mechanical Engineers, Rubber & Plastics Conference, Lawrence Hotel, Erie, Penna.

Oct. 10-13. Technical Association of the Pulp and Paper Industry, 10th Corrugated Containers Conference, Royal York Hotel, Toronto, Ontario, Canada.

Oct. 11-14. Architectural Woodwork Institute, National Meeting, Sheraton-Park Hotel, Washington, D.C.

Oct. 13-14. Committee D-14 on Adhesives, American Society for Testing Materials, Del Prado Hotel, Chicago, Ill.

Oct. 16-19. Technical Association of the Pulp and Paper Industry, 15th Plastics-Paper Conference, Hotel Syracuse, Syracuse, N.Y.

Oct. 23-27. Technical Association of the Pulp and Paper Industry, 15th Engineering Conference, Robert Meyer Hotel, Jacksonville, Fla.

Oct. 24-26. Envelope Manufacturers Association of America, Annual Convention, Waldorf-Astoria Hotel, New York, N.Y.

Oct. 25-27. American Standards Association, National Conference on Standards, Sheraton-Atlantic Hotel, New York, N.Y.

Oct. 27-29. National Paint, Varnish and Lacquer Association, 73rd Annual Meeting, Drake Hotel, Chicago, Ill.

Portrait Of

ROBERT M. KELL

A principal chemical engineer at Battelle Memorial Institute, Columbus, Ohio, since 1952, Robert M. Kell has done extensive research on adhesives and adhesion. His work reflects his belief in the necessity of studying adhesives as part of a total bonding system.

Some of the problems with which he has been concerned are: planning of industrial adhesives programs; developing formulations of elastomer-based adhesives; formulating adhesives for high-temperature metal - to - metal applications; studying the surface properties of materials as an aspect of various adhesive systems; developing epoxy- and phenolic-resin adhesives for structural uses; formulating sealants for aircraft fuel tanks.

Mr. Kell received his bachelor's degree in chemical engineering from Ohio State University in 1947, and his master's degree in 1948. For several years thereafter, he was associated with the Mathieson Chemical Corp. as a research and development engineer.

The author of several publications in the rubber and plastics field, Mr. Kell is active in professional societies. He was recently elected membership secretary of Committee D-14 on Adhesives of the American Society for Testing Materials. This is in addition to his post as secretary of the Committee's Subcommittee III, on Tests for Permanance of Adhesives. Mr. Kell is a member of the American Chemical Society.

Eastman Overseas Units

Tennessee Eastman Co., and Texas Eastman Co., have set up a new overseas marketing unit with the establishment of an International Division. The new division will handle worldwide sales and service of fibers, chemicals and plastics, except in the United States and Canada, where the sales agents will continue to be Eastman Chemical Products, Inc.

The division reports that two subsidiary corporations are being formed to handle the marketing. Eastman Chemical International AG, with headquarters in Zug, Switzerland, and a branch office in The Hague, Netherlands, will be responsible for sales in Europe, the Middle East and North Africa.

The other subsidiary, Eastman Chemical Ltd., will handle sales in Central America, South America, Australia, New Zealand, South Africa and the Far East. It will have its main office in Nassau, B.W.I., and a branch office in Hong Kong. The Hong Kong office was opened on August 1, and the Nassau and Zug facilities will open early in September, the division states.

Kleen-Stik Wins Award

A dispenser package produced by Kleen-Stik Products, Inc., Chicago, Ill., for its new two-sided adhesive in tape form, received one of three awards for "Best Packaging Design" in competition at the Art Material Trade Show held recently at the Edgewater Beach Hotel in Chicago, Ill.

The unique package houses a new pressure-sensitive, two-sided adhesive that is carried on a release-coated carrier strip. The adhesive is rolled on a three inch core. Scores and die-cuts allow the center-fold section to form a convenient hand grip. The center fold follows the contour of the core, anchoring it, adding strength to the package. There is a serrated metal cutting edge on the dispenser's open top, making the adhesive easy to cut.

Becco Moves to N.Y.

Becco Chemical Division, Food Machinery & Chemical Corp., has moved its administrative and sales headquarters from Buffalo, N.Y., to new offices located at 161 East 42nd St., New York 17, N.Y. D. H. Nelson, division manager, reports that personnel included in the move are Dewey H. Nelson, Albert P. Shutts and John R. Hopkins.

New UC Epoxy Plant

Commercial-scale production of a new family of high-purity, light-stable epoxies is now underway at the Institute of West Va. plant of Union Carbide Chemicals Co., New York, N.Y. The multimillion-dollar peracetic acid plant is producing both Unox epoxides and Flexol epoxy plasticizers. According to the company, the success of the operation has led to price reductions for several of the epoxides.

The family of Flexol products are low-cost stabilizers and plasticizers for vinyl chloride resins. Their synergistic action with many metallic vinyl stabilizers increases the resistance of vinyls to heat and light degradation. Unox epoxides are said to be the only commercial-scale epoxides with cyloaliphatic structures that eliminate light-unstable phenolic groups found in epoxies based on epichlorhydrin and bisphenol A.

D-14 Tests Published

Two new test methods and one specification recommended by ASTM Committee D-14 on Adhesives have been accepted for publication by the American Society for Testing Materials. The three items accepted are: Tentative Specification for Adhesive for Acoustical Materials (D 1779-60T); Tentative Recommended Practice for Conducting Creep Tests of Metal-to-Metal Adhesives (D 1780-60T); and Tentative Method for Climbing Drum Peel Test for Adhesives (D 1781-60T).

The next meeting of Committee D-14 on Adhesives will be held on October 13 and 14, at the Del Prado Hotel in Chicago, Ill.

"Of all things—inventing one adhesive to replace all adhesives."

Little Forms Division

Arthur D. Little, Inc., Cambridge, Mass., industrial research company, has established a Life Sciences Division which will examine space age living, with its emphasis on synthetics. Activities of the division will be directed by Dr. Charles J. Kensler who has been appointed vice-president. Dr. Kensler was formerly chairman of the Department of Pharmacology and Experimental Therapeutics, School of Medicine, Boston University. The new division will investigate uses of biology in industrial processes and in evaluating effects of industrial products on man and animals.

Latex Seed Protector

Vulcanol, a synthetic rubber latex in a variety of bright colors, finds application in the landscaping areas. The elastomeric polymer base for the product is supplied by Firestone Tire & Rubber Co., Akron, Ohio, and the material itself is produced by Alco Oil & Chemical Corp., Philadelphia, Penn. Vulcanol has been tested as a substitute for, or in conjunction with, conventional hay or straw mulch. It is diluted with water and sprayed over bare soil, and forms a web-like coating which prevents erosion during germination of the seed.

Acquiring Roddis Plywood

Weyerhaeuser Co., Tacoma, Wash., is completing arrangements to acquire the properties of Roddis Plywood Corp., Marshfield, Wisc. The acquisition will mark Weyerhaeuser's entry into the hardwood field. Roddis manufactures such hardwood products as veneers, doors, lumber and plywood which are distributed through its own wholesale outlets. Weyerhaeuser reports that it plans to operate Roddis intact as a division.

Dow Building Phenol Plants

Dow Chemical of Canada plans to construct a phenol plant at Tilbury Island, near Vancouver, British Columbia, Canada. The new plant will be on a 123-acre site. Construction will get underway during the Fall and production is planned by mid-1961. The company also reports that construction is underway on a facility at Fort Saskatchewan, Alberta, Canada, to produce pentachlorophenol and dichlorophenol.

By MELVIN NORD

Improving the Adhesiveness of Gelatin for Capsules

U. S. Patent 2,928,128, issued March 15, 1960 to Gustav H. Carlson and Robert P. Scherer, assigned to R. P. Scherer Corp., discloses an improved method for preparing soft gelatin capsules from a gelatin composition containing reworked gelatin net. The success of this process depends in large part upon the ability of the gelatin webs or ribbons to adhere together to form a seal. Failure of this seal at any point about the capsule periphery will result, of course, in the complete capsule being leaky.

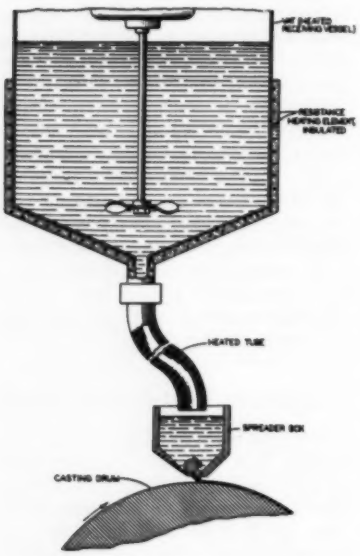


Figure 1

What remains of the gelatin ribbon or web after the material required for the capsules has been severed therefrom is known as "net," since it resembles a net in appearance. It is customary to rework the net either by direct remelting and reuse or by incorporation with gelatin masses prepared directly from fresh granular or flake gelatin containing plasticizer, flavors, dyes and preservatives. The gelatin compound is then melted and placed in a large heated vat from which it is discharged into smaller hoppers or spreader boxes mounted above the drums on which the gelatin is cast to form the ribbons. In commercial production of capsules, this vat will normally hold sufficient gelatin to supply the capsulating machine for 16-24 hours, depending upon the thickness of the ribbon film.

The vat is heated to maintain the gelatin at a temperature of 125° to 140° F., preferably 135° F., which keeps it at the proper casting viscosity. It had been found that under these conditions, the last one-quarter or one-third of the gelatin in the vat will produce sheets that do not seal satisfactorily. To avoid leaky capsules, this material hitherto has been discarded.

It has now been found that the difficulty can be obviated by thoroughly stirring the vat of gelatin so that the quantity being dispensed from the vat is completely and constantly agitated until the casting operation. The agitation apparently prevents orientations and polymerizations of the protein molecules and thus terminal amino and carboxyl groups, and possibly more so, secondary molecular attractions, remain activated to produce tenacious seals, for gelatin compositions which have been thoroughly agitated remain tacky and seal tightly even after 18-24 hours at elevated temperatures in the range of 125° to 145° F.

Figure 1 shows a method of carrying out the invention. The gelatin may be mixed by an electrically operated stirrer disposed within a vat, the bottom portion of which is heated with a resistance heating element. The thoroughly agitated gelatin composition is conducted from the vat to the spreader box through a heated tube. The spreader box is mounted just above the casting drum and serves to deposit a thin film of gelatin on the surface of the drum. A rotating spindle within the spreader box insures uniform distribution of the gelatin from the slot in the bottom of the box.

Coated Heat-Sealable Wrapper

U. S. Patent 2,927,865, issued March 8, 1960 to Dan Lewis, Jr. and John S. Barton, assigned to Crown Zellerbach Corp., relates to a wrapping material for frozen foodstuffs, which has been rendered moisture-proof by waxing and which is capable of being heat-sealed in such a manner that it will maintain a strong bond regardless of subsequent prolonged exposure to sub-freezing temperatures. The advantages can be seen immediately.

A face of the paper sheet is coated with a fluid, pigmented coating composition containing a finely divided coating pigment and a polyvinyl acetate resin. The coated paper, after being dried, is supercalendered, rendering the surface smooth and receptive to printing ink. After printing, as desired, the coated paper is given a treatment of wax.

The resultant coated and waxed sheet presents a finished, glossy surface which is heat-sealable, and, when heat-sealed, will maintain its seal even though exposed over a prolonged period to temperatures as low as 10° F.

Due to some physical interaction between the pigmented polyvinyl acetate resin and the film of wax, which occurs under the heat-sealing, a tenacious bond is set up between the heat-sealed surfaces and this bond will not delaminate, even under low temperatures, and can be broken only by rupture of the paper sheet.

Solvent-Resistant Pressure-Sensitive Adhesive Tape

U. S. Patent 2,925,174, issued Feb. 16, 1960 to Robert H. Stow and assigned to Minnesota Mining & Mfg. Co., provides a solvent-resistant pressure-sensitive adhesive tape.

It has now been found that pressure-sensitive adhesive compositions having, while wet with solvent, the unique combination of thumb appeal and retention of cohesion, as well as other required properties of pressure-sensitive adhesives, can be formed from pressure-sensitive copolymers of certain non-tertiary alcohol esters of acrylic acid. The formulation also requires small proportions of additive copolymerizable monoethylenic monomers containing, bonded to an ethylenic carbon —at least one strongly polar group which is attached through a carbonyl radical.

Flat Tape Applicator

U. S. Patent 2,932,421, issued April 12, 1960 to Ernest H. Schiefer, describes a portable, hand-operated, flat tape applicator which applies adhesive tape along the edge of a sheet of material.

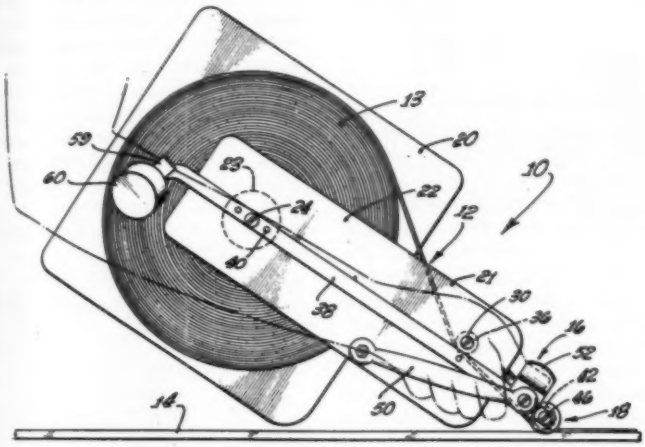


Figure 2

The applicator is shown in Figure 2. It consists essentially of a tape-supporting means (12) for supporting a roll of tape (13), and a pressure means (16) mounted on the supporting means for receiving and applying pressure to the free end of the unadhesive side of the tape to force the adhesive side of the tape to adhere to the edge of the sheet of material (14). A guiding means (18) is mounted adjacent to the pressure means for engaging the edge of the sheet of material and guiding the application of the tape so that it will be positioned along the edge of the sheet of material.

Polyvinyl Alcohol Adhesive

U.S. Patent 2,916,468, issued Dec. 8, 1959 to Albert P. Yundt and Keith E. Bradway, assigned to Union Bag-Camp Paper Corp., provides a size or adhesive based on polyvinyl alcohol having a degree of combination with urea-formaldehyde compositions greater than was previously possible.

The present invention contemplates the direct addition of formaldehyde and urea to the PVA solution under mild acidic conditions and with the formaldehyde greatly in excess of the urea in molal ratio.

As an example, a wash resistant size for textile application was prepared as follows: 5 grms of medium viscosity 77 per cent hydrolyzed PVA was mixed with 6.8 grams of formaldehyde (37 per cent solution), 1.5 grams of urea, and 40 grams of water. This mixture was adjusted to a pH of 6.0 with dilute acetic acid and cooked at 195°F. for 30 minutes. Then 0.5 gram urea was added and the solution was diluted with water to a 3 per cent concentration. 0.5 gram ammonium metaphosphate was added as a catalyst and the solution was used to treat an unsized muslin. After ten minutes on a steam heated drier drum at 225°F., the size was cured sufficiently to be retained after repeated washing.

Wet-Strength Paper

U. S. Patent 2,926,116, issued Feb. 23, 1960 to Gerald I. Keim and assigned to Hercules Powder Co., describes a method of making wet-strength paper. The material applied to the paper pulp is an uncured thermosetting cationic resin comprising a water-soluble polymeric reaction product of epichlorohydrin and a polyamide derived from a polyalkylene polyamine and a saturated aliphatic dibasic carboxylic acid containing 3-10 carbon atoms. It has been found that resins of this type impart wet-strength to paper whether made under acid, alkaline, or neutral conditions.

Dextrin-Dextran Adhesives

U. S. Patent 2,933,407, issued April 19, 1960 to Everette E. Witt and Frederick W. Holt, Jr., assigned to The Commonwealth Engineering Co. of Ohio, discloses an adhesive composition characterized by good tack and quick grab.

The composition consists of the following constituents by weight: 100 parts water, 90 parts dextrin, and 10 parts dextran. The dextran contains 86-97 per cent of the glucosidic 1,6 linkages and has a molecular weight between 20,000 and that of native, unhydrolyzed dextran.

Fluorocarbon Sizing Agents

U. S. Patent 2,920,979, issued Jan. 12, 1960 to Lawrence J. Hessburg and Gayle L. Rengel, assigned to Minnesota Mining & Manufacturing Co., describes a method of coating a sized paper with wax or asphalt without objectionable strike-through.

The paper is sized with an oleophobic fluorocarbon sizing agent on the side opposite to that to be coated. Preferred oleophobic fluorocarbon sizing agents are the chromium coordination complexes of fluorocarbon monocarboxylic acids.

Other Patents of Interest

Subject	Inventor or Assignee	Patent No.	Date
Plastering material	Pabcor, Inc.	2,931,733	4/5/60
Vulcanizable bonding composition	Universal Oil Products Co.	2,932,622	4/12/60
Label dispensing machine	Kleen-Stik Products, Inc.	2,933,216	4/19/60
Printing pastes	The Commonwealth Engineering Co. of Ohio	2,933,403	4/19/60
Coating for containers	Dow Corning Corp.	2,934,235	4/26/60
Fortified rosin size	American Cyanamid Co.	2,934,468	4/26/60

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

new equipment

Electronic High-Vacuum Pump

Suited for general laboratory use, the new Series 150 UlteVac electronic high-vacuum pump is also suitable for applications ranging from vacuum-tube processing to

thin-film work. Based on a cold-cathode pumping structure, the Series 150 pumps room air at 5 liters per second. A roughing vacuum of 15 to 20 microns is required only for starting, after which the system may be sealed off. Features include a compact all-metal coupling with rotable flanges to permit any desired orientation of the pump. In operation, the pump draws current in linear relationship with pressure. This permits the pump to double as a vacuum gage. The pump is said to produce a clean ultimate vacuum below $1x10^{-9}$ mm Hg. The unit weighs 13 pounds and its dimensions are 6½ by 7¾ by 5 inches. *Ultek Corp.* **E-216**

Drum Resin Mixer

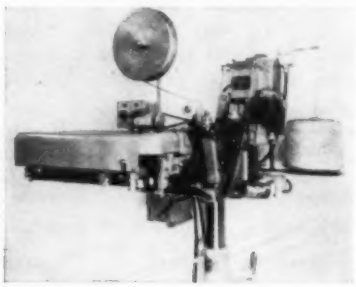
A new self-contained and self-supporting drum type Resin Mixer has been introduced. It features a disc type blade which shears in and disperses solid materials rapidly with a minimum of air entrapment. According to the manufacturer, its bottom-to-top blending action effects a uniform mix, and the low-heat build-up lessens kick-over hazard. A counter-balanced motor can be cranked up or down for easy loadings. The mixer comes in three horsepower ranges and three disc diameters. *Dake Corporation.* **E-217**

Resin Mixing System

A lower-priced 100 Series of the NoVo Metering and Mixing System for reactive resins, is said by the company to incorporate many of the features of the original system which sold at almost double the price. The new unit can handle both continuous flow and intermittent individual shots. It meters, mixes and dispenses reactive liquid systems, including the polyurethane foams, polyurethane casting resins, epoxy resins, polyesters, polysulfides, silicones, and others. It comes complete with double-acting electrically driven piston type metering element, reservoirs, solvent purge system, all controls and the same mixing head used on the more expensive system. The system is available in both mild and stainless steel and may be used in conjunction with all the standard accessories. *NoVo Industrial Corporation.* **E-218**

Bag Closing Machine

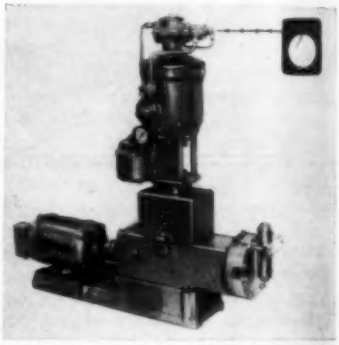
A Thermoplastic Tape-Top bag closing machine designed to apply a thermoplastic tape closure over sewing on open-mouth multiwall shipping sacks has been developed.



It provides maximum protection against contamination from outside particles and creates a moisture barrier to prevent caking of hygroscopic products. Physical and chemical characteristics are said to be retained over the full range of temperatures encountered in bagged products. Features of the machine are automatic starting, thread cutting, and tape application and cutting components. *Bemis Bro. Bag Co.* **E-219**

Electronic Metering Pumps

New Pulsafeeder metering pumps feature electronic control and instantaneous response. Capable of handling corrosive and non-corrosive liquid chemicals, they come in three types: a combination Electro-Pneumatic; an All-Electric; and an Electro-Hydraulic. On the Electro-Pneumatic model (APE) the actuator takes an electronic signal from a controller which in turn pneumatically operates an air cylinder. Supply air powering the cylinder can be from 30 psi to 100 psi. The electronic input from the controller can



be 0.5 to 5 milliamperes, 74 to 144 volts, or other ranges as needed. The All-Electric Actuator model (AE) is designed to take an electronic signal from either remote manual adjustment of Pulsafeeder outputs or automatic control from an instrument. It consists of a gear box, reversible electric motor, slide-wire feedback, and light switches. A calibrated rheostat permits remote resetting of a predetermined output. Pulsafeeders fitted with the self-contained Electro-Hydraulic model (EH) actuater take a low level DC or AC input signal for positioning and a standard electric power, single or three phase, for actuation. Standard signal range is 4 milliamperes DC. For AC input signals a rectifier is supplied. *Lapp Insulator Co.* **E-220**

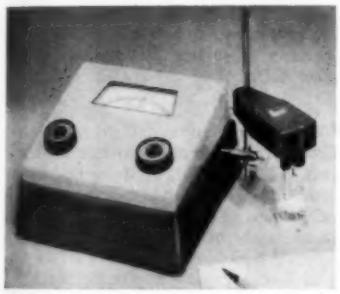
Tape Applicator for Bags

Equipped with a compact tape folding device, the new Thermogrip Applicator Model DN is capable of being readily incorporated into existing bag end closure equipment to produce moisture and soft proof closures. The tape folding assembly, with two adjustable tape guides and suitable mounting and adjusting bolts, accomplishes the folding and creasing of the tape over the bag. It can readily be mounted in a va-

riety of positions and is said to produce smooth, uniform folds in a number of different weights of tapes. The compact applicator, a nozzle type, works with the tape folder to dispense exactly the right amount of hot melt at an exact rate of speed to achieve quality bonding of the tape to the bag end. According to the manufacturer, primary usage is expected from makers of bags for hygroscopic materials, such as chemicals and fertilizers, where high moisture resistance is particularly desirable and from packers of such materials who will want to duplicate the tape closure after filling the bags. *United Shoe Machinery Corp.* **E-221**

Wide Range pH Meter

The Metrion pH meter is said to deliver precision usually found only in high priced pH meters, at a lower cost. It offers an extended range, utilizing large, clear, duplex scales



covering 0 to 10.0 pH and 4.0 to 14.0 pH. The electrode mounting system adapts perfectly to titrations and a wide range of sample volumes, the manufacturer states. The meter is housed in a compact case which has high resistance to shock, acids and stains. *Coleman Instruments.* **E-222**

Direct Metering Device

The Pour-Portioner is a gravity-metering feeder with head loss equalizer designed for use with air conditioning, cooling tower, and corrosive plant chemicals. It screws directly into all standard, chemical shipping drums and 2-inch threaded fittings, and is made of polyvinyl chloride and Teflon. It is said to be ideal for open-vessel feeding as well as adaptable to suction-side, or vacuum, line feeding. Drum changeover can be made quickly and without using tools or altering feed rate. *Sterling E. Norcross Companies.* **E-223**

Electronic Control Device

Sonac, an electronic control device, performs a wide variety of industrial control applications includ-

ing counting, sorting, routing, machine safeguard, plant protection, door control, and hopper and bin level control. It is a non-contact sensing and switching system using ultra-sonic energy for its beam. Sonac will sense liquids, solids, ferrous and non-ferrous metals, opaque or transparent objects. Sensors can be completely concealed or remotely located and their operation is not affected by ambient light, dust, mist, or a normal build-up of residual solids on the face of the acoustic lens. Power consumption is approximately one watt and sensors will operate in temperatures of plus 220° to −100°F. *Delavan Manufacturing Co.* **E-224**

Mixing and Metering Device

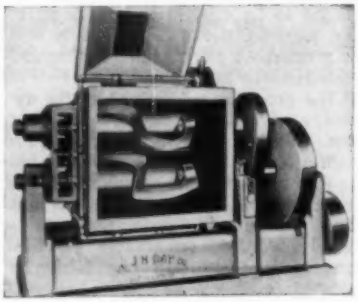
The Model 286 Automix is designed to automatically meter and mix two part compounds in a closed pressure system. Easily adapted for automation, according to the manufacturer, the unit provides intermittent or assembly line dispensing. It features positive displacement metering, variable mixing cycles, adjustable volumetric output and pressure material containers. The mixing head has a bayonet type disconnect and disposable cartridge liner. A complete line of accessories is available. *Semco Sales & Service, Inc.* **E-225**

Dual Application Mixer

A new line of mixers for the laboratory and for production, the Convertible Jet Mixer, ranges in size from ¼ horsepower to 15 horsepower models, with mixing capacity from 3 gallons to 3,000 gallons. According to the company each model may be converted in seconds from closed turbine to open turbine mixer, or vice versa, for dual application. The mixers blend materials of any viscosity which can be pumped or forced through the mixing head. The laboratory models have shaft speeds of up to 8,000 r.p.m., and the production units, up to 3,600 r.p.m. The distance between the rotor and the stator can be changed to decrease or increase the degree of shear and impact to which the material is subjected. Excessively viscous materials can be processed by removing the stator sleeve and operating the unit as an open turbine mixer. *Barrington Industries, Inc.* **E-226**

Double Arm Mixer

The Mogul double arm mixer is designed primarily for heavy duty mixing and kneading of viscous fluids and semi-solids such as adhesives, rubber cement, lacquers,



flushed colors, sealing compounds and plastics, states the manufacturer. It is reported that the mixer's heavy, rigid construction, oversize bearings, sturdy drives and solid alloy steel agitator shafts insure long life and reduce maintenance costs. The Mogul mixer comes in several models with capacities ranging from 2½ to 600 gallons. The small models mix experimental batches and small production quantities. They are designed to duplicate, in a test run, the exact characteristics encountered in production work using larger Mogul models. *J. H. Day Co.* **E-227**

Film Laminating Machine

The Rotobond A-3 Laminator operates with standard uncoated plastic films in thicknesses from .0005 to .0075 inch without the use of heat or solvents. The manufacturer recommends it particularly for laminating menu covers, labels, reproduction proofs, calendar cards, and a variety of other items which must be protected from dirt or grease. The machine comes in a table model for use with films up to 12 inches wide, and a floor model for work with films up to 24 inches wide. *Rotobond Inc.* **E-228**

book reviews

Industrial Maintenance Painting. *Written and Published by Paul E. Weaver, 4025 Brady St., Baton Rouge 5, La. 5 x 8 in. 189 pp. $5.50.*

Sometimes an author publishes his own technical work because it contains unorthodox theories or unverified data. In this book, the reason for the privately printed edition seems to have been its appeal to a fairly limited audience rather than any departure from the accepted methods of corrosion protection through paint and other coatings. It is a small manual intended to be used in training painters and foremen, but it serves equally well as a reference work of application and cost data for the specialist.

The procedures described by the author, a recognized mechanical engineer, were gathered from his own experience with a national chemical manufacturer, as well as from other companies' handbooks that he found of particular use. This background lends itself to a simply worded, remarkably practical presentation, although one fairly restricted in scope. Alternative ways of performing the same operation are often given, sources for tabular material and specifications are generally omitted. There are many engineering short cuts and rules of thumb which may help others to save time and money on their coating production lines. Perhaps the next edition can include more detail and comparative material, where the present version supplies only sketchy albeit provocative outlines, especially on alkyds, epoxy resins, vinyl, chlorinated rubber and phenolic coatings.

The Nature of Science. *By David Greenwood. Published by Philosophical Library, Inc., 15 East 40th St., New York, N.Y. 4½ x 7½ in. 95 pp. $3.75.*

The emphasis in the five essays that make up this small volume is on the linguistic aspects of science and mathematics, and the application of the most recent theories of syntax and semantics to the language of modern science. Using the term "natural science" to mean all theoretical knowledge which cannot be included under the heading of "divine science," the author points out that the development of the methods and conclusions of natural science is probably the most significant intellectual contribution to modern western civilization.

Mr. Greenwood does not distinguish between logic as applied to the empirical sciences and logic in general. In fact, he doubts if any real difference exists, since logic, he insists, is the discipline which "analyzes the meaning of the concepts common to all the sciences, and establishes the general laws governing the concepts."

Generally speaking, the author reinforces his views on the formalization of science as expressed in his previous book, "Truth and Meaning." The approach, as opposed to "intuitive" methods, has aroused considerable discussion in scientific and philosophic circles.

Physicist Rosgyll Ayres points out in his introduction that when abstract, nonintuitive formulas were first proposed as new axioms, some physicists endeavored to make them "intuitive" by constructing an analogy to a known process. This procedure, he notes, has only an aesthetic or heuristic value, and is not essential to the application of the theory.

Among the ideas advanced is the contention that the tendency towards formalization will increase as theories more and more take their special character from mathematics. On the horizon, presumably, is a unity of science embracing all known mathematical laws.

Analytical Chemistry of Titanium Metals and Compounds. *By Maurice Codell. Published by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y. 6 x 9 in. 378 pp. $12.00.*

Paints, textiles and ceramics are only a few of the many products making use of titanium compounds. In addition, titanium-base metals have loomed large on the industry horizon in recent years. For this reason, it is both important and advantageous to have technical information spread in numerous and difficult to obtain publications available in a single volume. The present volume not only does this, but includes previously unpublished laboratory reports and the investigations of analytical chemists who have never taken the time to publish their findings.

The book is designed so that by using the principles of analysis it offers, analytical chemists can make whatever modifications are necesary to analyze any given sample. The work is divided into four parts: general procedures; determination of metallic elements in titanium and titanium alloys; determination of nonmetallic elements in titanium and titanium alloys; analysis of titanium-base materials.

Trade Literature

Shot Meter-Mixer. A compact, accurate method of mixing, metering and dispensing flowable two part compounds and adhesives in intermittent or production line use is discussed in this 4-page brochure. The features described include: safety, accuracy, selectivity, durability, versatility, and portability. Since the mixing equipment is specifically designed and engineered to customer specifications, the brochure includes a customer requirement questionnaire which requests such data as: material manufactured, material weight or specific gravity, viscosities of materials, mixing ratio, output range, base material reservoir, accelerator or hardener reservoir, and operating temperatures. *Pyles Industries, Inc.* L-263

Bonding Guide Charts. Two new bonding guide charts give detailed information and specifications on the proper types of adhesives to be used in varying applications involving ceramic tile work and insulation projects, respectively. The easy-to-read charts, clearly cross-indexed for ready reference, show at a glance the specific adhesive product recommended for bonding any combination of materials. *Miracle Adhesives Corp.* L-264

Latest Developments in Adhesives, Coatings, Sealers. "Adhesive Horizons," No. 1, Vol. 3, is devised to assembling with high strength structural adhesives. The purpose of this issue is to show the reader what structural adhesives are, how they are used in general metalworking applications, and to illustrate solutions for assembly problems. *Adhesives, Coatings & Sealers Division, Minnesota Mining and Manufacturing Co.* L-265

Abrasive Compound. A four-page folder, "Carbo-Latex P5," covers applications for the company's new synthetic-latex abrasive compound. Developed jointly by the Carborundum Co. and Firestone Tire & Rubber Co., the cement discussed is said to have excellent affinity to concrete, asphalt, sealed wood, steel and all sound surfaces free of extraneous matter. Advantages of the product are listed. *The Carborundum Co.* L-266

New Cleanup Products. Data bulletins and price list covering two new products to be used for cleanup of epoxy and polyester resins are available. The two materials, Meta-Terge 1405 and Meta-Strip 702, come in both liquid and thixotropic gel forms, and are used for uncured epoxy and polyester resins, and for removing and stripping cured epoxy resins, respectively. *Mereco Products Division, Metachem Resins Corp.* L-267

TECHNOLOGY OF ADHESIVES AT YOUR FINGERTIPS

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Subscribers to ADHESIVES AGE may now obtain, from one central source, technical literature dealing with all aspects of the adhesives industry. One or more of the books listed here may be of invaluable assistance to you. Look this list over and check the books suited to your needs.

- **Adhesive Bonding of Metals—G. Epstein. $2.95.** Considers adhesives used with metals, indicating when an adhesive-bonded joint is advantageous; the type adhesive to use; how to use it, and how to design the joint for optimum performance. ☐

- **Adhesive Bonding of Reinforced Plastics—H. A. Perry. $8.75.** Survey of the design and assembly of structures and products, particularly glass-fiber-reinforced plastic products, by means of adhesives. Gives data on equipment and methods used to produce adhesive bonded joints. ☐

- **Adhesion and Adhesives—N. A. De Bruyne and R. Houwink. $14.50.** A collection of information on the scientific and technological aspects of adhesion. Part I deals with theory, while Part II is devoted to the technology of adhesion. ☐

- **Epoxy Resins—Their Applications and Technology—H. Lee and K. Neville. $8.00.** Guide to the field of epoxy resins, covering the chemistry of their preparation and applications, including a section on adhesives. ☐

- **Polyamide Resins—Donald E. Floyd. $4.50.** Discusses in detail various important applications of the polymers belonging to the polyamide resin family and includes a comprehensive section on adhesives. ☐

- **Principles of High Polymer Theory and Practice—A. X. Schmidt and C. A. Marlies. $13.50.** Study of the principles of high-polymer theory and practice, with a section on adhesives, their applications, and mechanisms and factors involved. ☐

- **Recent Advances in Gelatine and Glue Research—G. Stainsby (Editor). $12.00.** Study of Collagen, and its protein gelatine, comprising papers and Proceedings of an International Conference of the British Gelatine and Glue Research Association. ☐

- **Vinyl Resins—Mayo Smith. $5.75.** Surveys applications of vinyl resins with information on their types, properties, chemistry, manufacture and fabrication. Includes information on several types of adhesives in this category. ☐

- **Epoxy Resins—Irving Skeist. $5.50.** A chapter on adhesives is included in this complete study of the entire field of epoxy resins. The author gives formulations, trade names, methods of manufacture and applications. ☐

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Cross-indexed Manual. "Mystik Brand Adhesives" is a loose-leaf booklet, revised to contain full information on several new products and providing comprehensive information on the physical characteristics and typical applications of the company's line of industrial tapes, bulk adhesives, coatings, and other pressure-sensitive products. It cross-indexes products by Armed Forces specification data, by tape type, by tape function, and by industrial application. *Mystik Adhesive Products Inc.* L-268

Samples of Gummed Papers. Samples of gummed papers are contained in two attractively packaged kits, the "Really Flat Printer Kit," and the "Prone Kit." Papers in both kits come in colors as well as in white, to illustrate the company's full line. *Mid-States Gummed Paper Division, Minnesota Mining and Manufacturing Co.* L-269

A Company History. A 20-page color-illustrated brochure entitled "The Story of Derby Sealers," covers company background, research and development, production facilities, products, and distribution. Plant facilities and products are pictured, as are the lines of Derby Sealer gummed tape dispensers and label moisteners, Grip-A-Tab pressure-sensitive tape dispensers, and pressure-sensitive label dispensers and applicators. *Derby Sealers, Inc.* L-270

Electric CodeTaper. "How the Self-Inking CodeTaper Operates" is a 12-page booklet that describes in detail the operation of a unit which permits the printing of such information as contents, identification, production or packing dates on sealing tape, as cartons are being sealed. A "how-to" booklet about Model 555 CodeTaper discusses such operations as: how to remove and insert the ink roll; remove and insert type roll; insert tape; ink roll width adjustments; base lock type roll width adjustment; align print roll and tape; adjust ink roll pressure; adjust ink flow; change color and replenish ink; insert removable type and mats; and clean type and mats. *Better Packages, Inc.* L-271

Controlled Evaporation. Bulletin No. 6017 illustrates an all-weather tank vent that is pre-engineered to keep gasoline, solvent and chemical tanks under low pressure or vacuum at all times, thereby reducing evaporation losses. The advantages of the unit, called ConverVent, are described, and a specifications table included. *Midland Specialties Co.* L-272

Finishes and Sealers. Rez finishes and sealers are described in this 4-page brochure. The finishes for exterior and interior applications are derived from alkyd resin. The pamphlet contains a color chart and gives data on use, application and coverage. *Rez Wood-Tones, Inc.* L-273

Vinyl Resin for Coatings. Bakelite Brand vinyl resin VMCH is described in this 16-page technical data booklet. Discussed in detail are the general properties of the resin, including specifications, solubility, heat stability, light stability, and adhesion to clean metal. The booklet explains that resin VMCH adheres very well on air-drying to iron, steel, cadmium and brass. Since the technology of resin VMCH follows that for resin VYHH in many respects, emphasis is placed on the points of difference between the two resins. *Union Carbide Plastics Co.* L-274

Case-Sealing Machines. This eight page booklet on the Packomatic Omnimatic-Rotopress describes a fully-automatic case sealer which seals and discharges corrugated shipping containers of all sizes, adjusting to different dimensions. Operating details of the machine are fully diagrammed and illustrated, and complete specifications are contained in the bulletin. *J. L. Ferguson Co.* L-275

Self-Adhesive Materials. This booklet on Fasson's self-adhesive products is illustrated with a series of the company's four-color ads. It describes the range of materials in which the products are offered and discusses applications. Materials covered are: self-adhesive vinyl, printing paper, and silk screened markings. *Fasson Products.* L-276

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in passing

Water, Water Everywhere

Most people think of resin (or plastic) coatings as protection against or containers for water; hence, water insoluble. But new breeds of water-soluble resins are now pushing their waves into our everyday living as paint thickeners, packaging, cosmetics, additives, coatings for paper and textiles, and many other consumer and industrial uses.

These synthetics are forging into markets long the domain of starches and natural gums. The stakes are huge; the total market for all types of starches and water-soluble gums (natural and synthetic) is more than 3-billion pounds a year. Starches alone account for 2.5-billion pounds and gums (such as tragacanth, arabic, and karaya) account for a robust 350-million pounds.

However, the synthetics have not been marking time. And they're getting set to move ahead. Reason: three major technological trends:

(1) Modern industry needs tailor-made ingredients with specific properties.

(2) Today's high production costs demand easy-to-handle materials.

(3) Stream and water pollution laws point up advantages of the low biological-oxygen-demand of synthetic water-soluble resins.

Today's top sellers among the synthetic water-soluble gums (or resins) are carboxymethyl cellulose (CMC), polyvinyl alcohol (PVA), methyl cellulose, and hydroxyethyl cellulose (Cellosize). Too, the newer poly-(ethylene oxide) resins promise significant uses in textile and paper treating and as water-soluble films for packaging.

Varying Growth Rates

Point to remember in estimating area sales potentials: Although the U.S. population has been increasing at a rate of 1.7 per cent a year this past decade, not all areas have increased at the same rate. The Pacific states (including Hawaii and Alaska) have the highest rate of increase, 3.1 per cent a year. Other area rates:

2.9% a year—Mountain States
2.2% a year—South Atlantic
2.0% a year—E. North Central
1.5% a year—W. South Central
1.2% a year—Middle Atlantic
1.0% a year—W. North Central
0.9% a year—New England
0.5% a year—E. South Central

Source: Statistical Bureau of Metropolitan Life Insurance Company, New York 10, N.Y.

How Much?

Industry dug down into its collective advertising budget and shelled out $503.5 million for business paper space in 1959. That's the first time business paper dollar volume has hit the half-billion-dollar mark. The figure, taken from Associated Business Publications' annual study of leading advertisers, is $10.1 million more than the $493.4 million 1958 total, a 2% gain; and compares with $489 million for 1957, $440 million for 1956, $390 million for 1955, $372 million for 1954, $350 million for 1953, and $300 million for 1952.

Expanding?

Cost of modernizing and expanding facilities of a large corporation are staggering. Officials of the Goodyear Tire & Rubber Company, for example, report that the firm has spent more than $5,500 an hour on capital expansion since 1946. Modernization and expansion projects in the past 14 years have cost over $674 million, representing 122,640 hours. This makes the investment rate $5,579 per hour.

High Finance

The District Office of Internal Revenue at Albuquerque, New Mexico, received this income tax return from a nine year old boy: "Allowance, 50 cents per week, 50 × 52 equals $26; pulling nails, 25 cents; letting Joe hit me, 5 cents; not hitting him back, 3 cents; total $27.08. Spent all but 12 cents, am sending you this and it makes me even." The 12 cents, which came in taped to a piece of paper, was returned for his "standard deduction."

Clean Hands

According to *National Safety News* a man leaving the men's room was told by his supervisor to observe the sign that said, "This is a food plant. Wash your hands before returning to work." The man looked puzzled and answered, "But I'm not returning to work. I'm going to eat my lunch."

Better or Worse

Few men, if any, are impelled to enter matrimony in order to save taxes. It is interesting to note, however, that a married man with an annual income of $10,000 will pay $9,000 less in income taxes in the course of 20 years than the single man.